

**ENERGY ENGINEERING
ANALYSIS PROGRAM**

AT

FORT LEAVENWORTH, KANSAS

FINAL SUBMITTAL

**ENERGY SURVEY
BUILDING 111 - BELL HALL
EXECUTIVE SUMMARY**

CONTRACT NUMBER DACA41-86-C-0061

JUNE 4, 1990



**KANSAS CITY DISTRICT
CORPS OF ENGINEERS**

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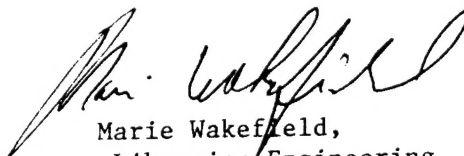
DEPARTMENT OF THE ARMY
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Introduction:

Bell Hall (Building No. 111) at Ft. Leavenworth, constructed in 1957, has undergone one major addition completed in 1986. Bell Hall is primarily used for officer training, which was its original intent. Over the years, equipment loads within the facility have increased, mainly due to increased computer usage. The original construction of this facility did not anticipate the additional computer load and the present mechanical and electrical systems are undersized. The systems are not capable of providing cooling all year; which is a requirement for the new computers. Since its implementation, the HVAC systems have had problems maintaining environmental control. Saving energy and improving environmental control at the same time for this facility will be a difficult task. Many of the systems don't maintain the minimum temperature and ventilation levels in the building and are shut down most of the time. Modifying these systems to use less energy will require construction modifications to allow proper operation. This increased the cost of the ECO's and made reasonable paybacks difficult to achieve.

Scope:

Under Base Contract No. DACA41-86-C-0061, an energy audit and engineering study Bell Hall Building No. 111 was performed. The scope included the following:

- A. Measure supply, exhaust and return air volumes for each air supply system in the building.
- B. Review and observe HVAC system controls.
- C. Perform a field audit of facility's lighting levels, miscellaneous equipment loads and occupant quantities.
- D. Verify lighting and occupant schedules through field observation and personal interview.
- E. Provide adequate documentation of field investigation

notes.

- F. Develop a computer simulation of the buildings base energy consumption using daily and hourly simulation procedures.
- G. Determine possible methods of energy conservation and simulate energy conservation methods using an hourly computer simulation program, and compare results to the base line model.
- H. Determine probable construction costs for each energy conservation method and perform a life cycle cost analysis of the project using the information gathered.

Note: The electrical / lighting portion of this project was performed and the ECO's have already been implemented under another contract.

Work Accomplished:

The field survey on Bell Hall at Ft. Leavenworth was started in September of 1986. It included measuring 29 air supply systems, counting all facility lighting, measuring miscellaneous electrical loads, recording zone temperatures, measuring exhaust volumes, measuring boiler combustion efficiency, measuring chillers operating parameters, counting occupants, observing typical facility operation and interviewing occupants and operating personnel. All data collected through this investigation was then entered into a computer database for manipulation.

From the field data, building plans, and previous energy studies we simulated the facility's energy consumption on the PCDOE computer program. Once the base energy consumption of the facility was developed we made additional computer simulation runs for each Energy Conservation Opportunity (ECO). We then determined energy savings and prepared preliminary probable construction cost estimates for each of the ECO's. The savings investment ratio (SIR) was computed

for each ECO. ECO description data, probable construction cost, energy savings and economic analysis are included in Volume I, Section II of this submittal. All computer simulation results are included in Volume II of this submittal.

Building Data

The facility's HVAC system consists of 5 multizone air supply systems, 24 unit ventilators, 1 built up VAV system, 2 packaged single zone DX systems, 6 packaged thru the wall air conditioners, 13 single zone heating and cooling supply systems, 3 make-up air ventilation systems and 240 two-pipe fan coil units. The unit ventilators, multizone air supply systems, built-up VAV system and 2 of the constant volume air supply systems have economizer capability. The fan coil units are two-pipe with one coil which is used for both heating and cooling. The Classrooms, Eisenhower Auditorium and Marshall Auditorium have perimeter radiation systems for perimeter heating. These systems are only active when the boiler is operating.

The central heating/cooling plant consist of 3 boilers, 2 chillers, 1 cooling tower and 14 base mounted pumps. Since piping arrangement is a 2-pipe system, the central plant is either providing heating or cooling but is not capable of providing simultaneous heating and cooling. Reference figures No. 1 and 2 for the flow schematics of the heating and cooling at Bell Hall.

Classrooms (Original Facility):

The unit ventilators serve the classrooms in the original part of the facility. They provide ventilation and economizer air in the winter and provide cooling and ventilation air in the summer. The units are manually switched from summer to winter operations by a summer/winter switch located in the boiler room of Bell Hall. In the winter, the economizers on the unit ventilators are activated to allow for winter cooling. The economizer does not look at the room temperature to see if cooling is

required. Therefore, if no cooling air is required, the air is reheated to room temperature by the unit ventilator coil which wastes energy. This control sequence was analyzed in detail under ECO-M7.

Office Wing:

The office wing in the original facility is served from the two-pipe fan coil system for heating and cooling. Ventilation air is provided by a roof-top air handling unit (RTU-3) and is intended to operate all year. However, RTU-3 is out of service and is not allowed to operate in cold temperature due to coil freeze-up. Inspection so this unit indicates that it is badly damaged and needs to be replaced. In addition, unit's pipe insulation is damaged from previous repairs.

Facility Maintenance:

Presently the facility has one maintenance engineer on temporary assignment from 7:30 a.m. to 4:30 p.m. Prior to the installation of the building automation system Bell Hall had three, full time maintenance engineers. These positions were eliminated. None of the air systems in Bell Hall have clean usable filters. Some of the air systems did not even have filters. Based on the condition of air filters and other items requiring periodic maintenance, we recommend the post consider increasing the maintenance operations staff assigned to the building.

BELL HALL BUILDING 111

EXISTING ANNUAL ENERGY CONSUMPTION

ELECTRICITY		
KWH	DOLLARS	MBTU
8,725,854	\$461,611	29,781

NATURAL GAS		
THERMS	DOLLARS	MBTU
2.78E-07	\$87,550	27,794

TOTAL	
DOLLARS	MBTU
\$549,160	57,575

ENERGY CONSERVATION ANALYSIS

ALL ECOs INVESTIGATED -- BELL HALL BLDG 111

ECO	DESCRIPTION	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
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HEATING VENTILATION AND AIR CONDITIONING

M1	Convert existing multi-zone air handling units to VAV	6015.0	\$34,842	\$320,775	\$352,853	10.1	1.09
M2	Convert office and classrooms to 4-pipe system with VAV	13983.0	\$63,500	\$3,495,843	\$3,845,427	60.6	0.19
M3	Convert existing 2-pipe system to 4-pipe	7448.0	\$30,800	\$1,720,729	\$1,892,802	61.5	0.19
M4	Modified Class Room ventilators outdoor air control sequence	21405.0	\$107,363	\$77,873	\$85,660	0.8	14.40
M5	Condenser water temperature reset	219.0	\$3,395	\$14,621	\$16,083	4.7	1.93
M6	Provide fan shutdown during night and off peak hours	6573.0	\$42,178	\$32,168	\$35,385	0.8	12.79
M7	Boiler Oxygen Trim Control						
M8	Provide new heat recovery chiller	3302.0	\$9,600	\$2,150,586	\$2,365,645	246.4	0.05
M9	Convert to primary/secondary pumping system	2274.0	\$38,680	\$314,356	\$345,792	8.9	1.01
M10	Reduce cooling tower fan power	186.0	\$2,883	\$22,359	\$24,595	8.5	1.07

BUILDING ENVELOPE

A1	Install Double Pane Windows	343.0	\$1,600	\$51,461	\$56,607	35.4	0.47
A2	New roof (existing building)	1399.0	\$8,600	\$135,508	\$149,059	17.3	0.86
A3	Reduce qty of dock doors and provide dock seals	271.0	\$1,100	\$32,313	\$35,545	32.3	0.55
A4	Reduce Solar Load with solar films	1942.0	\$16,788	\$144,891	\$159,380	9.5	1.43
A5	Air Curtains	340.0	\$1,330	\$18,472	\$20,319	15.3	1.21
A6	Wall Insulation w/ reduction in window area (option a)	1541.0	\$16,800	\$1,517,272	\$1,668,999	99.3	0.13
A6	Wall Insulation w/ reduction in window area (option b)	1541.0	\$16,800	\$552,000	\$607,200	36.1	0.35

ENERGY CONSERVATION ANALYSIS

ECOs RECOMMENDED -- BELL HALL BLDG 111

ECO	DESCRIPTION	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
-----	-------------	---------------------------	------------------------	----------------------	---------------------------	----------------------------	-----

HEATING VENTILATION AND AIR CONDITIONING

M1	Convert existing multi-zone air handling units to VAV	6015.0	\$34,842	\$320,775	\$352,853	10.1	1.09
M4	Modified Class Room ventilators outdoor air control sequence	21405.0	\$107,363	\$77,873	\$85,660	0.8	14.40
M5	Condenser water temperature reset	219.0	\$3,395	\$14,621	\$16,083	4.7	1.93
M6	Provide fan shutdown during night and off peak hours	6573.0	\$42,178	\$32,168	\$35,385	0.8	12.79
M9	Convert to primary/secondary pumping system	2274.0	\$38,680	\$314,356	\$345,792	8.9	1.01
M10	Reduce cooling tower fan power	186.0	\$2,883	\$22,359	\$24,595	8.5	1.07

BUILDING ENVELOPE

A4	Reduce Solar Load with solar films	1942.0	\$16,788	\$144,891	\$159,380	9.5	1.43
A5	Air Curtains	340.0	\$1,330	\$18,472	\$20,319	15.3	1.21

ENERGY CONSERVATION ANALYSIS

ECOs REJECTED -- BELL HALL BLDG 111

ECO	DESCRIPTION	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS (\$)	CONSTRUCTION COST	TOTAL PROJECT COST*	SIMPLE PAYBACK YEARS	SIR
-----	-------------	---------------------------	------------------------	----------------------	------------------------	----------------------------	-----

HEATING VENTILATION AND AIR CONDITIONING

M2	Convert office and classrooms to 4-pipe system with VAV	13983.0	\$63,500	\$3,495,843	\$3,845,427	60.6	0.19
M3	Convert existing 2-pipe system to 4-pipe	7448.0	\$30,800	\$1,720,729	\$1,892,802	61.5	0.19
M7	Boiler Oxygen Trim Control						
M8	Provide new heat recovery chiller	3302.0	\$9,600	\$2,150,586	\$2,365,645	246.4	0.05

BUILDING ENVELOPE

A1	Install Double Pane Windows	343.0	\$1,600	\$51,461	\$56,607	35.4	0.47
A2	New roof (existing building)	1399.0	\$8,600	\$135,508	\$149,059	17.3	0.86
A3	Reduce qty of dock doors and provide dock seals	271.0	\$1,100	\$32,313	\$35,545	32.3	0.55
A6	Wall Insulation w/ reduction in window area (option a)	1541.0	\$16,800	\$1,517,272	\$1,668,999	99.3	0.13
A6	Wall Insulation w/ reduction in window area (option b)	1541.0	\$16,800	\$552,000	\$607,200	36.1	0.35

ENERGY CONSERVATION ANALYSIS
Bell Hall

Non-ECIP Projects

PROJECT GROUP BELL HALL BLDG 111	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 1						
Modify O.A. Controls Class Room Ventilators	ECO-M4	21405.0	\$107,363	\$85,660	0.8	14.56
Condenser Water Temp Rese	ECO-M5	219.0	\$3,395	\$16,083	4.7	1.93
Modulate Cooling Tower Fans	ECO-M10	186.0	\$2,883	\$24,595	8.5	1.07
Fan Shutdown - Night	ECO-M6	6573.0	\$42,178	\$35,385	0.8	12.79
GROUP 1 TOTALS		28383.0	\$155,819	\$161,723	1.0	10.78

GROUP 2						
Install Solar Film	ECO-A4	1942.0	\$16,788	\$159,380	9.5	1.43
Air Curtains at Dock Doors	ECO-A5	340.0	\$1,330	\$20,319	15.3	1.21
GROUP 2 TOTALS		2282.0	\$18,118	\$179,699	9.9	1.03

ECIP Projects

GROUP 3						
Convert Multi-Zone AHU to Variable Air Volume	ECO-M1	6015.0	\$34,842	\$352,853	10.1	1.09
Convert to Primary Secondary System	ECO-M9	2274.0	\$38,680	\$345,792	8.9	1.01
GROUP 3 TOTALS		8289.0	\$73,522	\$698,645	9.5	1.05

BELL HALL BUILDING 111

ENERGY AND COST SAVINGS

TOTAL POTENTIAL ENERGY AND COST SAVINGS

	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$/YR
GROUP 1	28,383	\$155,819
GROUP 2	2,282	\$18,118
GROUP 3	8,289	\$72,522
TOTAL	38,954	\$246,459

PERCENTAGE OF ENERGY CONSERVED

POTENTIAL ENERGY SAVINGS, MBTU	38,954
EXISTING ENERGY CONSUMPTION, MBTU	57,575
PERCENT ENERGY CONSERVED	67.7%

ENERGY USE AND COST

	ENERGY MBTU/YR	ENERGY \$/YR
BEFORE ECO IMPLEMENTATION	57,575	\$549,160
AFTER ECO IMPLEMENTATION	18,621	\$302,701

ENERGY CONSERVATION ANALYSIS
Bell Hall

Non-ECIP Projects

PROJECT GROUP BELL HALL BLDG 111	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 1						
Modify O.A. Controls Class Room Ventilators	ECO-M4	21405.0	\$107,363	\$85,660	0.8	14.56
Condenser Water Temp Rese	ECO-M5	219.0	\$3,395	\$16,083	4.7	1.93
Modulate Cooling Tower Fans	ECO-M10	186.0	\$2,883	\$24,595	8.5	1.07
Fan Shutdown - Night	ECO-M6	6573.0	\$42,178	\$35,385	0.8	12.79
GROUP 1 TOTALS		28383.0	\$155,819	\$161,723	1.0	10.78

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-M4

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M4) analyzes the energy savings that may be realized by modifying the ventilation air handling unit controls. The modifications will allow for the proper operation of the existing economizer system.

SCOPE:

This E.C.O. simulation (ECO-M4) will modify the controls to the existing classroom ventilation units to permit an effective economizer control operation. The modifications will include control modifications and a change in the sequence of operation for each unit ventilator. The control modifications will modulate the outside air and return air dampers during the cooler seasons of the year, based on the outside air temperature and the room air temperature conditions. The control valve(s) for the heating coil(s) will remain inoperative or closed unless the outside air conditions are below freezing. The control valve will be cracked open only when the outside air temperature drops below a determined set-point to prevent coil freezing. The room heating requirements will be satisfied by the existing fin tube radiation system.

Reference Figure No. 1. Modifications to the existing unit ventilators will require new temperature sensors, sequencing relays, and controllers to operate the face and bypass dampers and to operate the outside air and return air dampers. The existing dampers, damper motors, and room thermostats will remain as installed except for minor calibrations.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. Classroom unit ventilators were changed from the modified VAVS (re: **Modeling Techniques, Section I**) system to single zone heating and cooling system (SZRH).

SUMMARY:

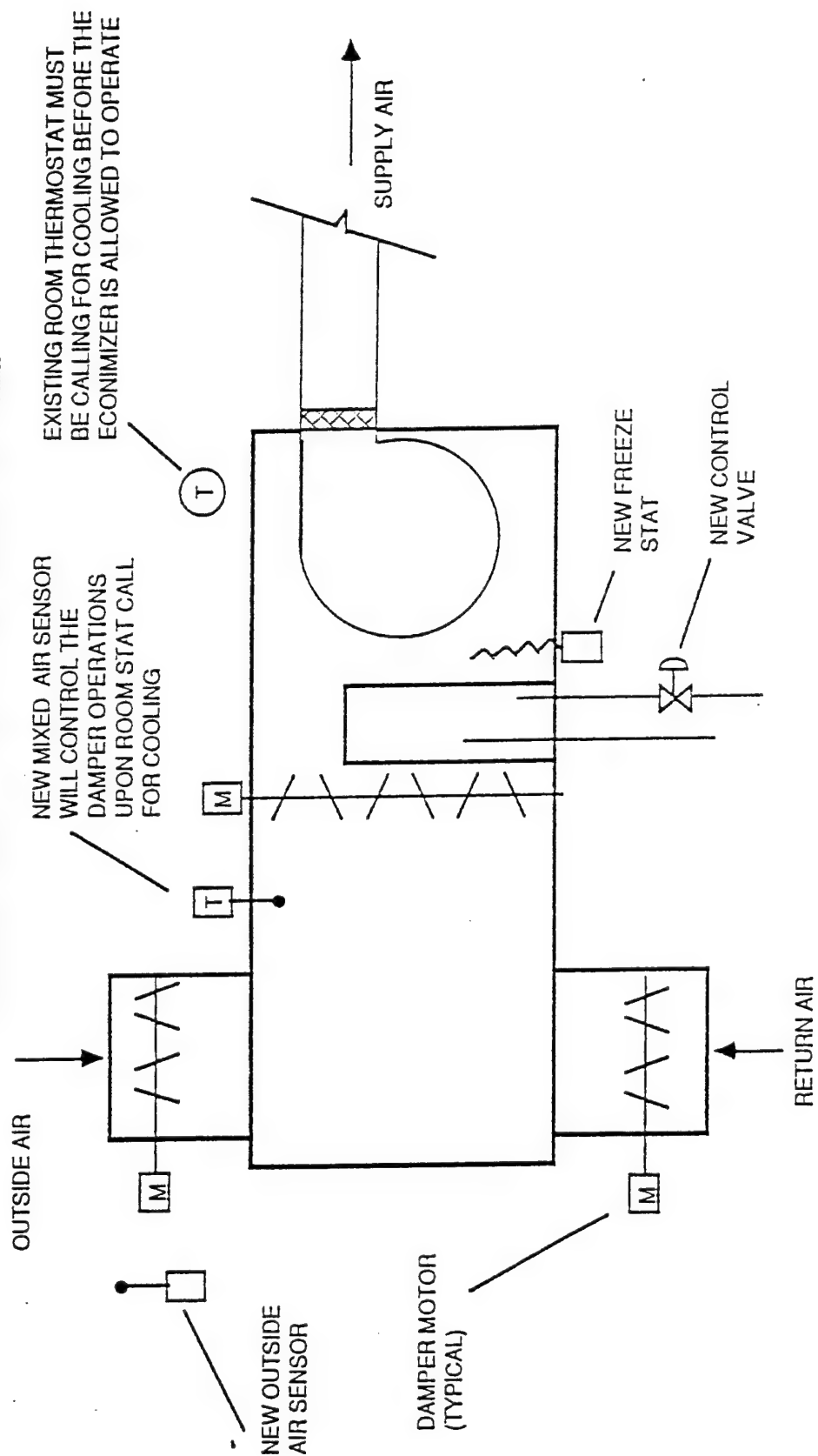
The probable project cost is \$85,700. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run (ECO-M4) are approximately 21,400 MBTU per year and \$110,400 per year.

The simple payback for this simulation is 0.7 years.

The savings to investment ratio (S.I.R.) for this simulation is 14.56.

DESCRIPTION: MODIFIED AIR HANDLER UNIT



ECO-M4
FIGURE NO. 1

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FT LEAVENWORTH
PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

STUDY: FTLVB8DLM
LCCID 1.001
REGION NO. 7

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOM4
ANALYSIS DATE: 05-31-89 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	77873.
B. SIOH	\$	7787.
C. DESIGN COST	\$	3894.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	80599.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	80599.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	3234.	\$ 50127.	8.59	430591.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	18170.	\$ 57236.	12.76	730325.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		21404.	\$ 107363.		\$ 1160916.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	383102.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	107363.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	1160916.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	14.40	
(IF < 1 PROJECT DOES NOT QUALIFY)		

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-M5

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M5) analyzes the energy savings that may be realized by allowing the chiller condenser water temperature to be controlled during low ambient wet bulb conditions.

SCOPE:

This E.C.O. simulation (ECO-M5) modifies the existing boiler room condenser piping loop. The modifications will allow the control of the condenser water temperature for optimum chiller operation. The construction work will include new pipe installation, existing pipe modifications, and control modifications.

Reference Figure No. 1 for the boiler room equipment layout and pipe modifications.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. The minimum condenser water temperature shown on line 2,340 (re: Volume II, Section I) was changed from 85° F. to 65° F.
2. The tower water temperature control was changed from "FIXED" to "FLOAT" on line 2,344.

SUMMARY:

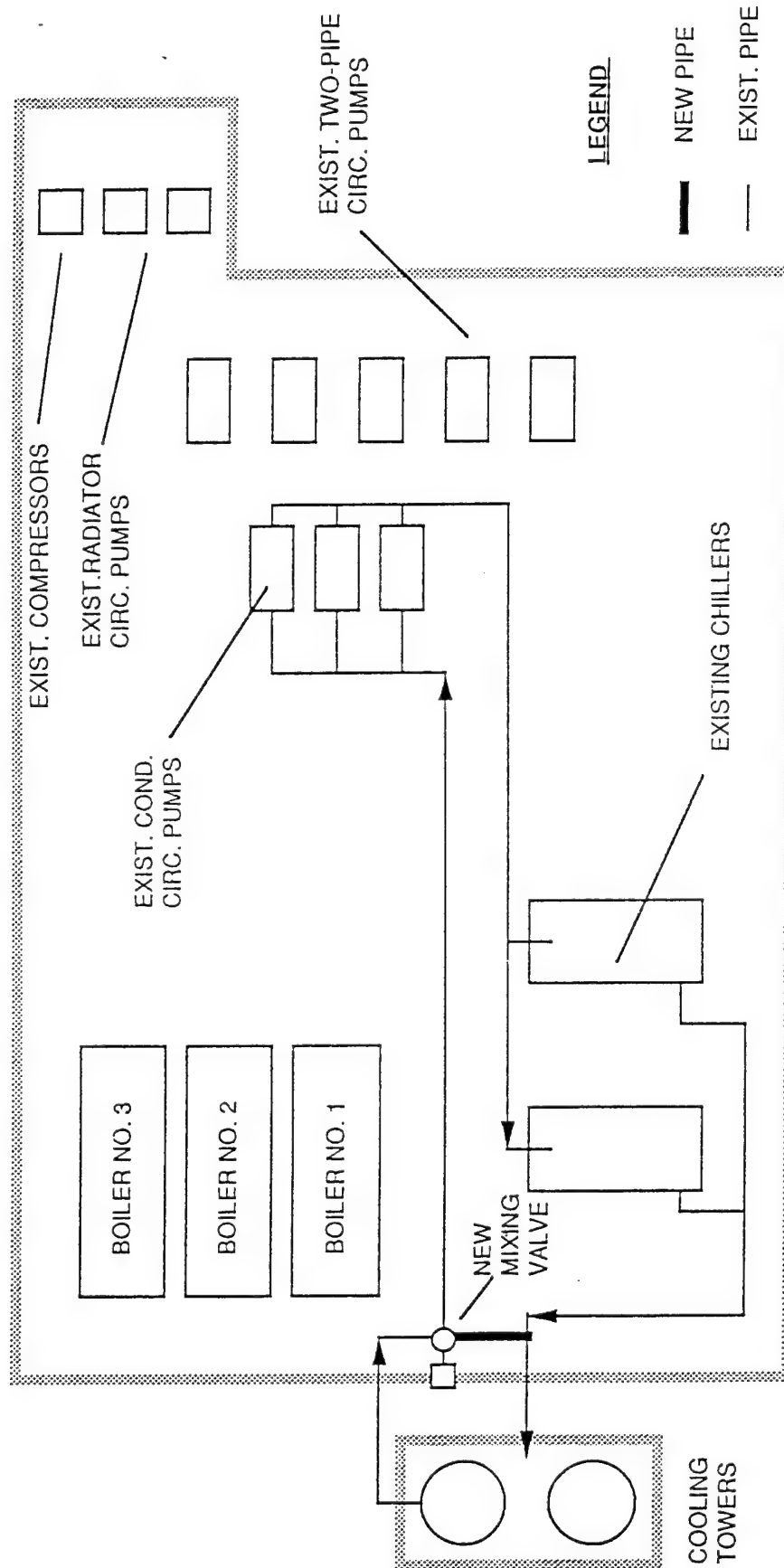
The probable project cost is \$14,650. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run (ECO-M5) are approximately 220 MBTU per year and \$3,400 per year.

The simple payback for this simulation is 4.3 years.

The savings to investment ratio (S.I.R.) for this simulation is 1.93.

DESCRIPTION: BOILER ROOM WITH MODIFIED CONDENSER PIPING SYSTEM



ECO-M5
FIGURE NO. 1

[illegible]

LIFE CYCLE COST ANALYSIS SUMMARY

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

INSTALLATION & LOCATION: FT LEAVENWORTH, KANSAS STUDY: FTLVBDLM
PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS LCCID 1.001 REGION NO. 7

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOM5
ANALYSIS DATE: 07-21-87 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	14621.
B. SIOH	\$	1462.
C. DESIGN COST	\$	731.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	15133.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	15133.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ 15.50	219.	\$ 3395.	8.59	29159.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	0.	\$ 0.	12.76	0.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		219.	\$ 3395.		\$ 29159.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	9622.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) = _____		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	3395.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	29159.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.93	
(IF < 1 PROJECT DOES NOT QUALIFY)		

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-M10

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M10) analyzes the energy savings that may be realized by allowing the cooling tower fans to operate with variable speed controllers.

SCOPE:

This E.C.O. simulation (ECO-M10) installs cooling tower fan variable speed controllers. The modification will require installation of the variable speed controller units in the existing boiler room and the electrical modifications to accommodate the controller installation. The construction work will include modifications to the Building Automation System software to monitor and control the variable speed controller unit.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. PC-DOE command "TWO-SPEED=TOWER-FAN-CONTROL" was inserted at Line No. 2,346 (re: Volume II, Section I)

SUMMARY:

The probable project cost is \$24,595. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run (ECO-M10) are approximately 200 MBTU per year and \$2,900 per year.

The simple payback for this simulation is 7.7 years.

The savings to investment ratio (S.I.R.) for this simulation is 1.07.

ENG. FORM 150
1AVC-59

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FTLVBDLM

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LCCID 1.001

INSTALLATION & LOCATION: FT LEAVENWORTH, KANSAS REGION NO. 7

PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOM10

ANALYSIS DATE: 07-21-87 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	22359.
B. SIOH	\$	2236.
C. DESIGN COST	\$	1118.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	23142.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	23142.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	186.	\$ 2883.	8.59	24765.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	0.	\$ 0.	12.76	0.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		186.	\$ 2883.		\$ 24765.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	8172.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 2883.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 24765.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.07
(IF < 1 PROJECT DOES NOT QUALIFY)

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-M6

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-M6) analyzes the energy savings that may be realized by turning off air handling units and mechanical equipment during the unoccupied periods of the day.

SCOPE:

This E.C.O. simulation (ECO-M6) will use the existing Building Automation Energy System to turn off existing mechanical equipment and air handling units during the unoccupied periods of the day. The equipment in this simulation includes the following:

1. Ventilation units in the class room areas
2. Ventilation units in the office areas of the general building and Johnson Wing
3. Ventilation units in the library and Marshall areas
4. Mechanical pumps for the chilled water and heating systems
5. Chiller units and associated tower fans and condenser pumps

This work may be accomplished by using the existing building automation system. The existing automation system presently has the capability to monitor and operate the existing mechanical equipment. To accomplish the shut down and start-up characteristics of this simulation, modifications to the building automation system software would be required. The installation of additional control sensors and components to accomplish this simulation will be minimal

compared to the overall project cost of upgrading the existing building automation system.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. Schedules named "FAN" and "FAN2" (Re: Volume I, Section I) on lines 1,612 and 1,614 were changed from continuous operation to a computer control operation. The fan schedules changed for the fans would de-energize at 10:00 p.m. and restart at 5:00 a.m. on weekdays and de-energize at 6:00 p.m. and restart at 6:00 a.m. on weekends and holidays.
2. Set fan cycling to allow fans to cycle on to maintain a minimum of 55 ° F. (AR -1127) during unoccupied periods.

SUMMARY:

The probable project cost is \$35,385. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run (ECO-M6) are approximately 6,600 MBTU per year and \$43,000 per year.

The simple payback for this simulation is 0.7 years.

The savings to investment ratio (S.I.R.) for this simulation is 12.79.

ENG. FORM 150
1AVC-59

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FTLVB DLM

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.001

INSTALLATION & LOCATION: FT LEAVENWORTH, KANSAS REGION NO. 7

PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOM6

ANALYSIS DATE: 07-21-87 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	32168.
B. SIOH	\$	3217.
C. DESIGN COST	\$	1608.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	33294.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	33294.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU (1)	SAVINGS MBTU/YR (2)	ANNUAL \$ SAVINGS (3)	DISCOUNT FACTOR (4)	DISCOUNTED SAVINGS (5)
A. ELECT	\$ 15.50	1739.	\$ 26955.	8.59	231539.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	4833.	\$ 15224.	12.76	194258.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		6572.	\$ 42178.		\$ 425797.

3. NON ENERGY SAVINGS (+) / COST (-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS (+) /COST (-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	140513.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) = _____		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 42178.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 425797.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 12.79
(IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY
 ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
 INSTALLATION & LOCATION: FT LEAVENWORTH
 PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

STUDY: BHGROUP
 LCCID 1.001

REGION NO. 7

FISCAL YEAR 1987

DISCRETE PORTION NAME: GROUP1

ANALYSIS DATE: 05-31-89

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	147021.
B. SIOH	\$	14702.
C. DESIGN COST	\$	7351.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	152167.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	152167.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	5378.	\$ 83359.	8.59	716054.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	23003.	\$ 72459.	12.76	924583.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		28381.	\$ 155818.		\$ 1640636.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	541410.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	155818.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	1640636.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	10.78	
(IF < 1 PROJECT DOES NOT QUALIFY)		

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent a

Group 1 AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

ECO M4 - Modify the classroom ventilator controls to allow economizer operation when the outside air is cool enough to provide air conditioning, thus reducing the use of chilled water during moderate outdoor temperatures.

ECO M5 - Modify the condenser water piping and controls to allow operation of the central chillers with a lower condenser water temperature. This will improve the efficiency of the chillers when outdoor conditions are lower than the design temperatures, thus saving electrical energy during a large portion of the operating hours.

ECO M10 - Modify the cooling tower fans and controls to allow the fans to modulate according to the load with variable speed controllers. This will allow more precise control of the condenser water temperature helping to improve chiller efficiency and will also save fan horsepower because of the modulation.

ECO M6 - Reprogram the building automation system and install additional sensors and components to allow the air system fans to be shut off during unoccupied periods. This will save fan horsepower when no ventilation is required.

REQUESTER INFORMATION			
NAME	ORGANIZATION	TELEPHONE NO.	SIGNATURE

FORWARD FOR APPROVAL					
TO	RECOMMENDED ACTION	ENVIRONMENTAL IMPACT NO YES	ESTIMATED COST	WORK TO BE PERFORMED	FROM
	<input type="checkbox"/> APPROVAL	<input checked="" type="checkbox"/> <input type="checkbox"/> ENVIRONMENTAL CONSIDERATIONS	FUNDED \$ _____	<input type="checkbox"/> IN-HOUSE	FACILITIES
	<input type="checkbox"/> DISAPPROVAL	<input checked="" type="checkbox"/> <input type="checkbox"/> EIS/EIA INITIATED	WC <u>K</u> \$ <u>161,723</u>	<input type="checkbox"/> SELF-HELP	
APPROVING AUTHORITY _____		<input checked="" type="checkbox"/> <input type="checkbox"/> EIS/EIA COMPLETED	WC <u>L</u> \$ _____	<input type="checkbox"/> CONTRACT	DA _____
			WC _____ \$ _____	<input type="checkbox"/> TROOP	
			UNFUNDED \$ <u>7,351</u>		
			TOTAL \$ <u>169,074</u>		

														APPROVAL ACTION							
INS CODE			CHANGE	DOCUMENT NUMBER										ACTION TAKEN	DATE		SIGNATURE OF APPROVAL AUTHORITY	FORWARD			
				REQ ID	SERIAL NUMBER						FY	TYPE	MO		DA	DESIGN		DATE			
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side air is cool temperatures. s with a lower ions are lower ours. the load with ure helping to ts to allow the ventilation is	DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED																																																																														
	The existing economizer system does not operate efficiently and would therefore continue to waste energy. Chiller will not be at optimum operation which would continue to waste energy. Continued operation of air handling units during "off" hours would waste energy. Inadequate control of cooling tower fans wastes energy.																																																																														
PERSON TO CALL FOR ADDITIONAL INFORMATION																																																																															
NAME																																								ORGANIZATION																				TELEPHONE NO.																			

TO BE RMED		FROM		APPROVED FOR DESIGN		SOURCE OF FUNDS			
HOUSE		FACILITIES ENGINEER		SIGNATURE		DATE		<input type="checkbox"/> DIRECT <input type="checkbox"/> AUTOMATIC REIMB. <input type="checkbox"/> FUNDED REIMB.	
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GREEN - FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FOR APPROVAL" BLOCK

2

ENERGY CONSERVATION ANALYSIS
Bell Hall

Non-ECIP Projects

PROJECT GROUP BELL HALL BLDG 111	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 2						
Install Solar Film	ECO-A4	1942.0	\$16,788	\$159,380	9.5	1.43
Air Curtains at Dock Doors	ECO-A5	340.0	\$1,330	\$20,319	15.3	1.21
GROUP 2 TOTALS		2282.0	\$18,118	\$179,699	9.9	1.03

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-A4

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A4) analyzes the energy savings of installing solar shading on existing windows.

SCOPE:

The E.C.O. simulation (ECO-A4) installs solar shading on all existing windows.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. Comparison of savings for installing solar shading on existing windows which are presently unshaded.
2. The heat transfer characteristics for each window was compared in order to justify the additional cost of the solar shading.

SUMMARY:

The probable project cost is \$159,380. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run are approximately 1,942 MBTU per year and \$17,000 per year.

The simple payback for this simulation is 9.5 years.

The savings to investment ratio (S.I.R.) for this simulation is 1.43.

CONSTRUCTION COST ESTIMATE				DATE PREPARED 1/20/87		SHEET 1 OF 1	
PROJECT BELL HALL INSTALL SOLAR SHADING				BASIS FOR ESTIMATE <input checked="" type="checkbox"/> X CODE A (NO DESIGN COMPLETED) _____ CODE B (PRELIMINARY DESIGN) _____ CODE C (FINAL DESIGN) _____ OTHER (SPECIFY)			
LOCATION FORT LEAVENWORTH, KS							
ARCHITECT/ENGINEER HOLLIS & MILLER / CRB							
DRAWING NO.		ESTIMATOR		CHECKED BY			
SUMMARY: ECO-A4	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
SOLAR SHADING ON EXISTING WINDOWS	250	EA	\$75.00	\$18,750	\$325.00	\$81,250	\$100,000
SUBTOTAL:				\$18,750		\$81,250	\$100,000
CONTINGENCY			10.00%	\$1,875	10.00%	\$8,125	\$10,000
SUBTOTAL				\$20,625		\$89,375	\$110,000
COMP., TAX. SOC. SEC., INS.			13.50%	\$2,784	3.50%	\$3,128	\$5,913
SUBTOTAL				\$23,409		\$92,503	\$115,913
OVERHEAD AND PROFIT			25.00%	\$5,852	25.00%	\$23,126	\$28,978
CONSTRUCTION COSTS:				\$29,262		\$115,629	\$144,891

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FT LEAVENWORTH
PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

STUDY: FTLVEVBDL
LCCID 1.001
REGION NO. 7

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOA4
ANALYSIS DATE: 07-21-87 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	144891.
B. SIOH	\$	14489.
C. DESIGN COST	\$	7245.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	149962.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	149962.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	864.	\$ 13392.	11.05	147982.
B. DIST	\$.00	0.	\$ 0.	16.73	0.
C. RESID	\$.00	0.	\$ 0.	17.67	0.
D. NAT G	\$ 3.15	1078.	\$ 3396.	19.36	65741.
E. COAL	\$.00	0.	\$ 0.	13.47	0.
F. TOTAL		1942.	\$ 16788.		\$ 213722.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) / COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	70528.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=	_____	
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	16788.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	213722.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.43	
(IF < 1 PROJECT DOES NOT QUALIFY)		

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-A5

PURPOSE:

This Energy Conservation Opportunity simulation (ECO-A5) analyzes the energy savings of installing air curtains on existing dock doors.

SCOPE:

The E.C.O. simulation (ECO-A5) installs air curtains on the existing dock doors.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. Comparison of savings for installing air curtains on existing dock doors which presently do not have air curtains.
2. The heat transfer characteristics for each door was compared in order to justify the additional cost of air curtains.

SUMMARY:

The probable project cost is \$20,319. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run (ECO-A1) are approximately 340 MBTU per year and \$1,400 per year.

The simple payback for this simulation is 13.2 years.

The savings to investment ratio (S.I.R.) for this simulation is 1.12.

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FTLEVB DL

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.001

INSTALLATION & LOCATION: FT LEAVENWORTH, KANSAS REGION NO. 7

PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOA5

ANALYSIS DATE: 07-21-87 ECONOMIC LIFE 25 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	18472.
B. SIOH	\$	1847.
C. DESIGN COST	\$	924.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	19119.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	19119.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	21.	\$ 326.	11.05	3597.
B. DIST	\$.00	0.	\$ 0.	16.73	0.
C. RESID	\$.00	0.	\$ 0.	17.67	0.
D. NAT G	\$ 3.15	319.	\$ 1005.	19.36	19454.
E. COAL	\$.00	0.	\$ 0.	13.47	0.
F. TOTAL		340.	\$ 1330.		\$ 23051.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	11.65	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	7607.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) = _____		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 1330.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 23051.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.21
(IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FT LEAVENWORTH
PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

STUDY: BHGROUP
LCCID 1.001

REGION NO. 7

FISCAL YEAR 1987

DISCRETE PORTION NAME: GROUP2

ANALYSIS DATE: 05-31-89

ECONOMIC LIFE 15 YEARS

PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	163363.
B. SIOH	\$	16336.
C. DESIGN COST	\$	8168.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	169081.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	169081.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	885.	\$ 13718.	8.59	117833.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	1397.	\$ 4401.	12.76	56151.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		2282.	\$ 18118.		\$ 173984.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	57415.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	18118.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	173984.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)=	1.03	
(IF < 1 PROJECT DOES NOT QUALIFY)		

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent a

RING WORK REQUEST - XFA, XFB, XFC

Form 420-6; the proponent agency is the Office of the Chief of Engineers.

ON		SHORT JOB DESCRIPTION														BUILDING/FACILITY		BLANK																									
																NUMBER	SUFFIX																										
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
		H V A C load reduction in																																									
FACILITY		BUILDING/FACILITY				BUILDING/FACILITY				BUILDING/FACILITY				BUILDING/FACILITY				BLANK																									
SUFFIX		NUMBER		SUFFIX		NUMBER		SUFFIX		NUMBER		SUFFIX		NUMBER		SUFFIX																											
37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

is a major rate tempera- capacity and are unloading. uilding while

Without solar film, office over heating will be a continual source of problems for the office personnel and the mainten- ance personnel who must respond to complaints. Solar film is a more economical solution than increasing air conditioning capacity. If air curtains are not installed on the dock doors, infil- tration will continue to be a source of wasted energy. This ECO saves approximately 2282 million BTU's per year.

DESCRIBE WHAT WILL HAPPEN IF WORK IS NOT ACCOMPLISHED

PERSON TO CALL FOR ADDITIONAL INFORMATION

NAME	ORGANIZATION	TELEPHONE NO.

TO BE FROM		APPROVED FOR DESIGN		SOURCE OF FUNDS	
HOUSE	FACILITIES ENGINEER			<input type="checkbox"/> DIRECT <input type="checkbox"/> AUTOMATIC REIMB. <input type="checkbox"/> FUNDED REIMB.	
-HELP					
TRACT					
OP	DATE	SIGNATURE DATE			
		REMARKS			

FORWARDED TO							
DESIGN				ESTIMATOR			
MO	DA	MO	DA	MO	DA	MO	DA
19	20	21	22	23	24	25	26

UTHORITY

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- FORWARD TO KEYPUNCH AFTER COMPLETION OF "APPROVAL ACTION" BLOCK

GREEN - FORWARD TO KEYPUNCH AFTER COMPLETION OF "FORWARD FOR APPROVAL" BLOCK

②

ENERGY CONSERVATION ANALYSIS
Bell Hall

ECIP Projects

PROJECT GROUP BELL HALL BLDG 111	ECO	ENERGY SAVINGS MBTU/YR	ENERGY SAVINGS \$	PROJECT COST \$	SIMPLE PAYBACK YRS	SIR
GROUP 3						
Convert Multi-Zone AHU to Variable Air Volume	ECO-M1	6015.0	\$34,842	\$352,853	10.1	1.09
Convert to Primary Secondary System	ECO-M9	2274.0	\$38,680	\$345,792	8.9	1.01
GROUP 3 TOTALS		8289.0	\$73,522	\$698,645	9.5	1.05

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-M1

PURPOSE:

The purpose of this Energy Conservation Opportunity run (ECO-M1) is to analyze the energy savings that may be realized by converting the existing multi-zone ventilation units into variable air volume units.

SCOPE:

This E.C.O. simulation (ECO-M1) modifies all of the existing multi-zone ventilation units in the following areas:

1. Basement Office Area
2. Library Area
3. Archive Area
4. Eisenhower Auditorium Area
5. Bookstore and Barber Shop Area

The modifications will convert the existing units from a multi-zone system to a variable air volume system. The conversion includes ductwork modifications, minor piping modifications, control modifications and the installation of a variable speed controller assembly on each air handler unit.

The new ductwork modifications will retain the existing supply and return mains, but new variable air volume control boxes and new supply air diffusers will need to be installed.

The conversion of the ventilation units will include controls for the variable air volume boxes and controls to operate the new variable speed controller unit on each supply air fan. The modifications will require testing and balancing the air systems to assure proper operation.

Reference Figure No. 1 for the floor plan of the multi-zone areas that are being modified into variable air volume systems. Reference Figures No. 2 through 4 for sketches of the ductwork layout in the Archive, Basement and Library Areas.

MODELING TECHNIQUE:

The changes made to our base model for this simulation included the following:

1. The multi-zone system types were changed from MZS to VAVS.
This modification was made to all 5 multi-zone systems
2. Speed control option was added under SYSTEM-FANS Keyword Command to simulate the variable frequency drives

SUMMARY:

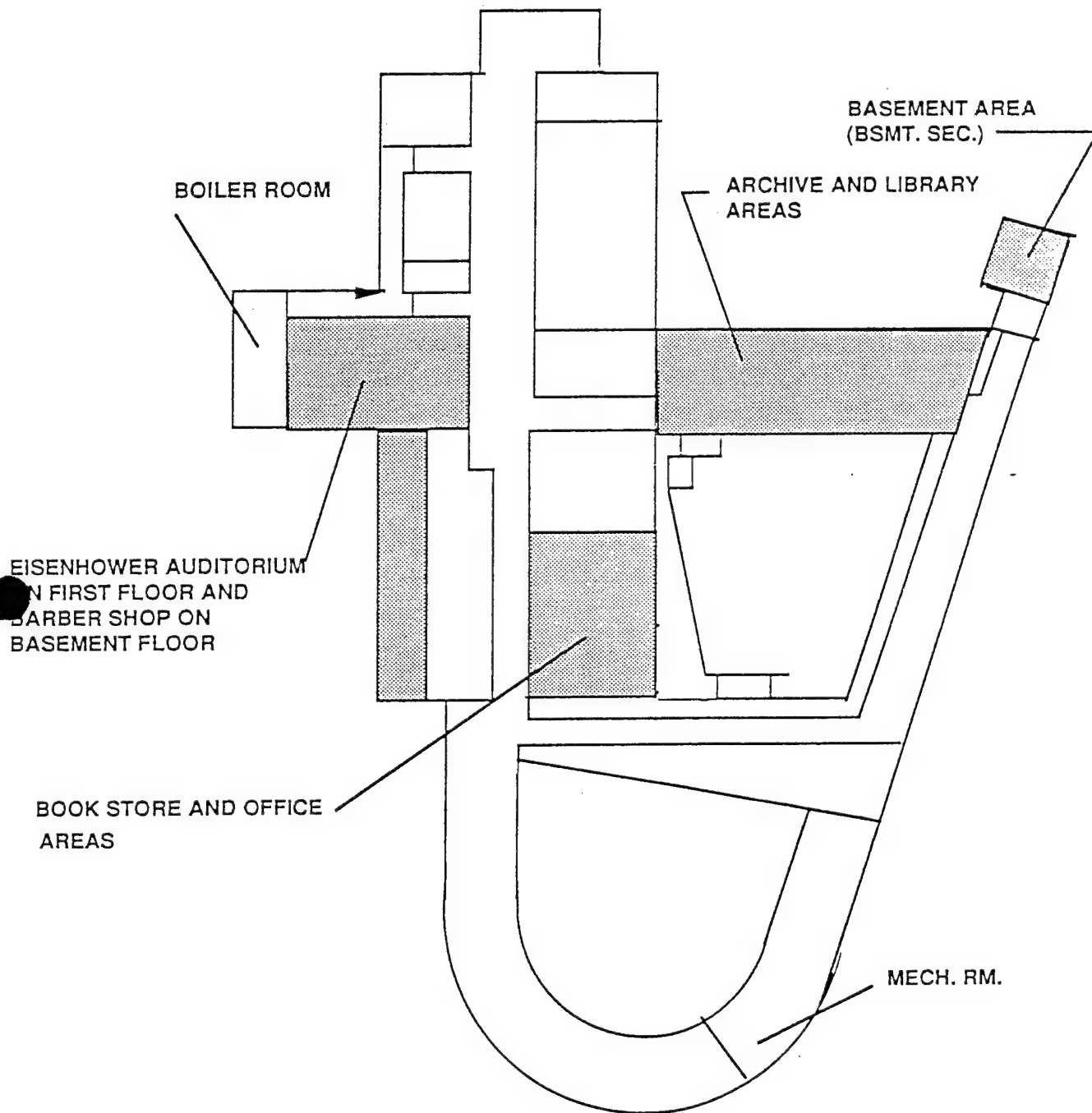
The probable project cost is \$352,853. This project cost is the construction cost plus 10% SIOH.

The energy savings realized by this E.C.O. run (ECO-M1) are approximately 6,000 MBTU per year and \$35,700 per year.

The simple payback for this simulation is 9.0 years.

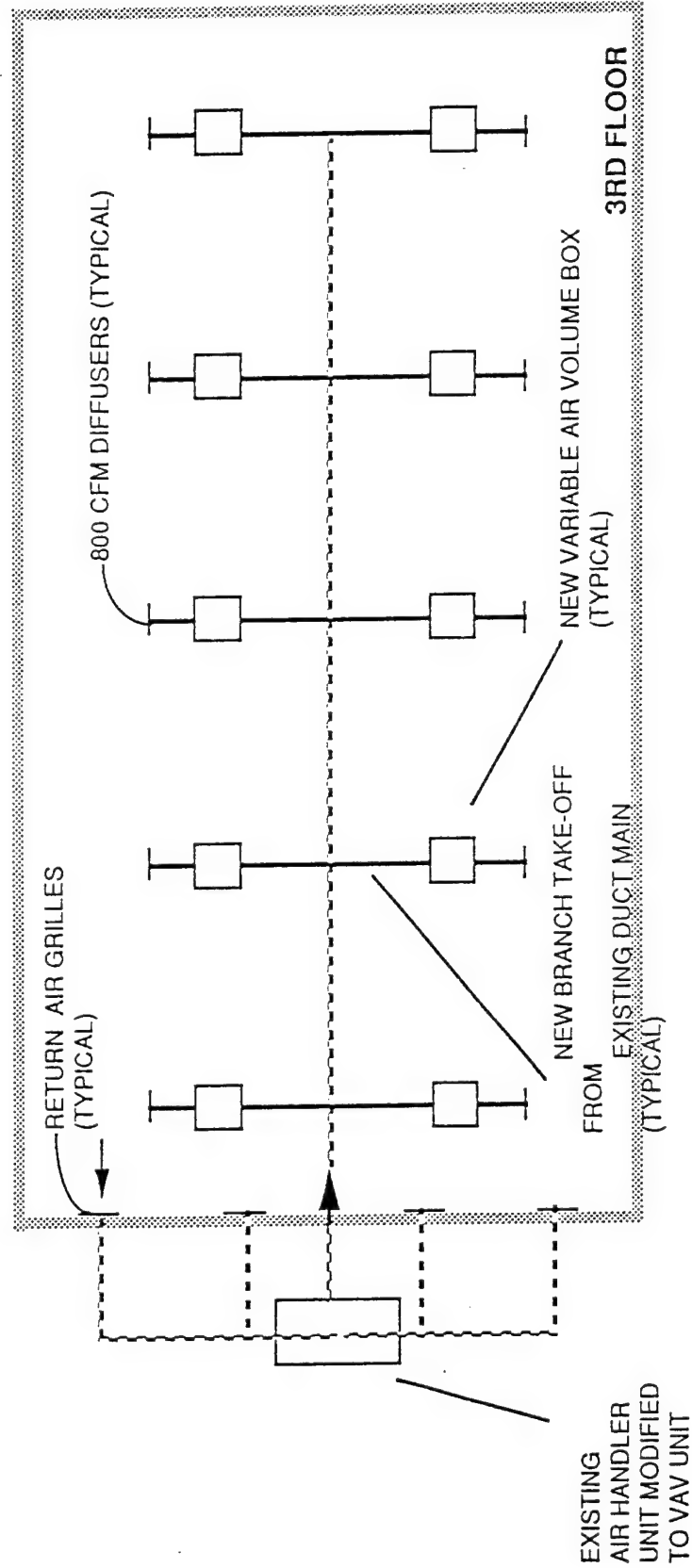
The savings to investment ratio (S.I.R.) for this simulation is 1.09.

DESCRIPTION: FLOOR PLAN OF EXISTING MULTI-ZONE AREAS



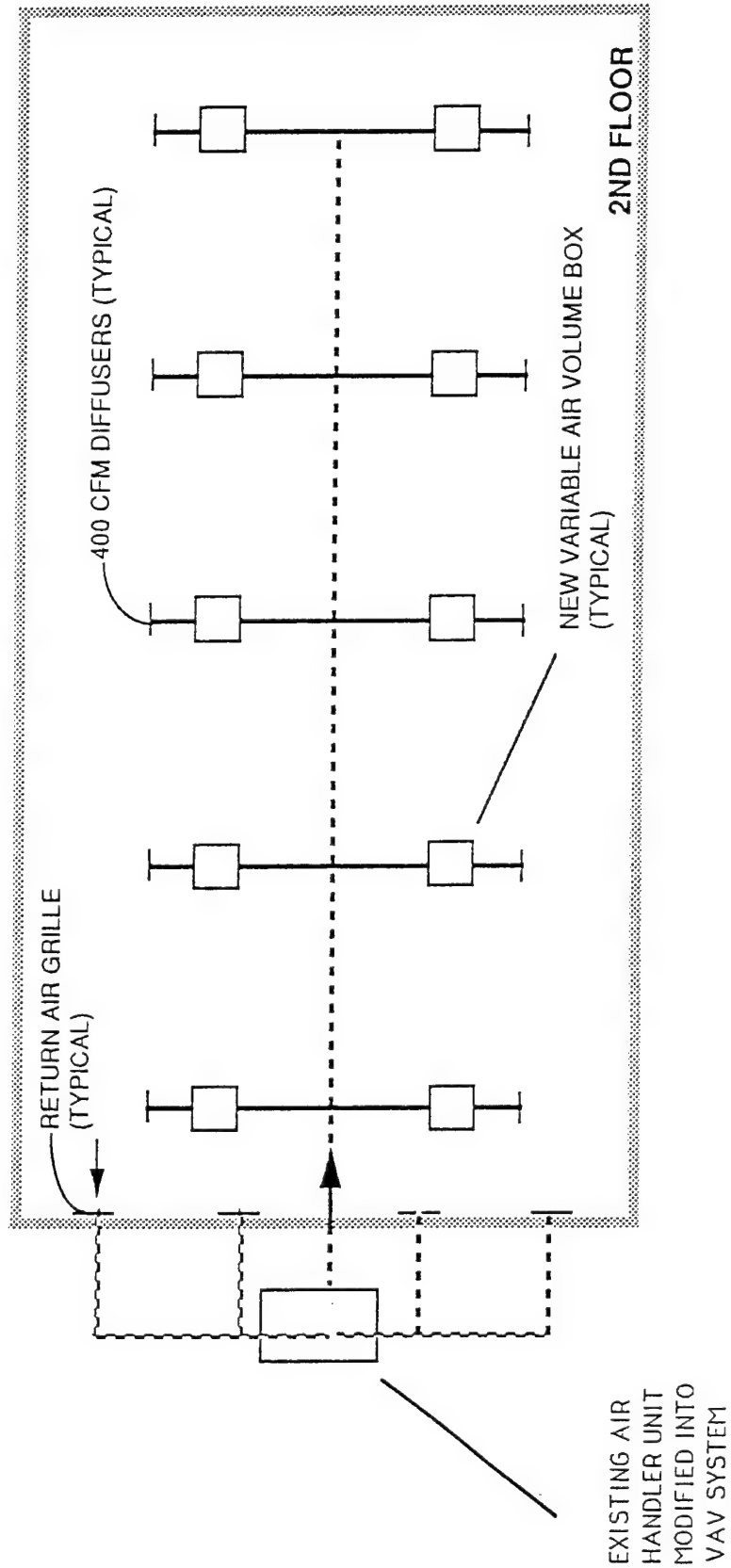
ECO-M1
FIGURE NO.1

DESCRIPTION : ARCHIVE AREA VARIABLE AIR VOLUME SYSTEM



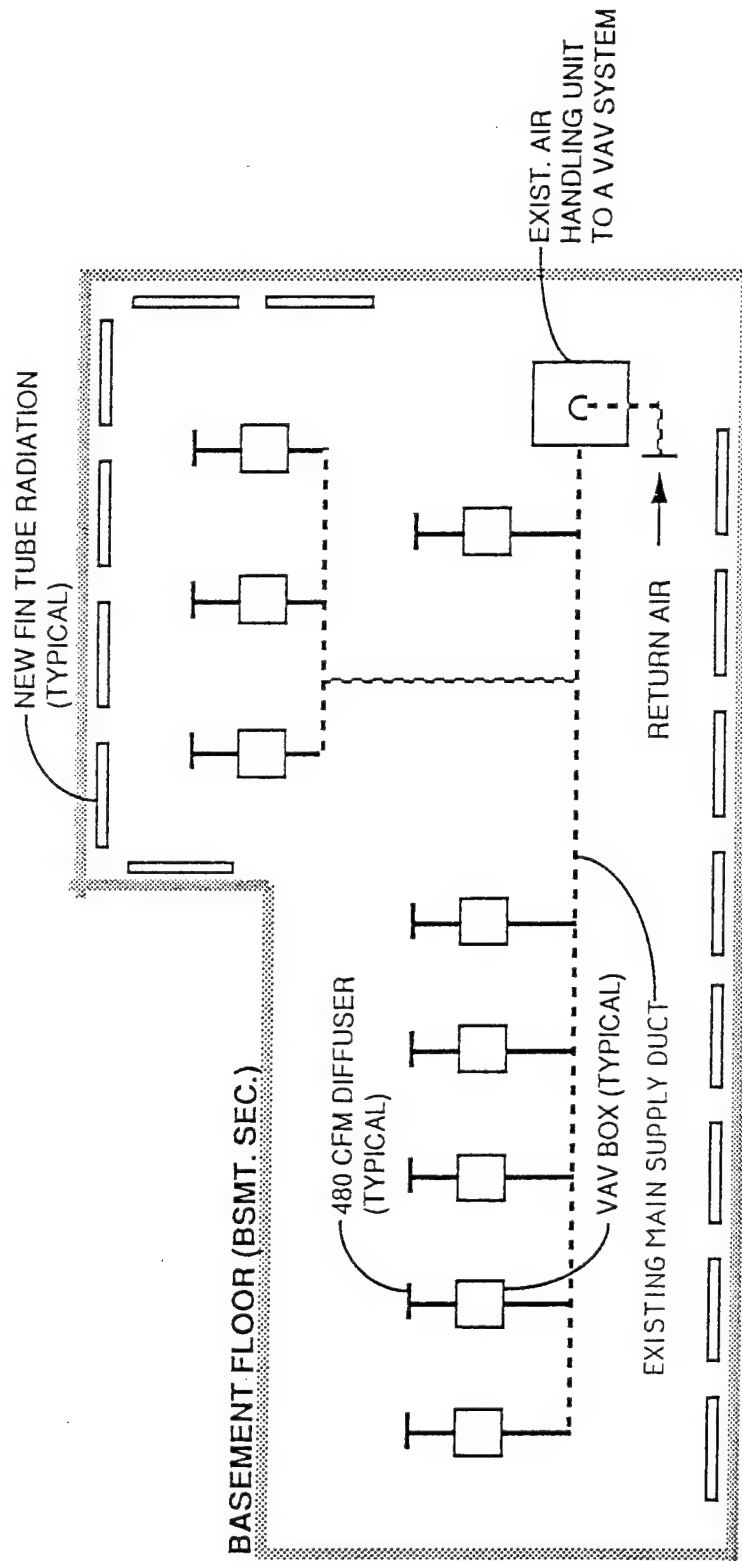
ECO-M1
FIGURE NO. 2

DESCRIPTION : LIBRARY VARIABLE AIR VOLUME SYSTEM



ECO-M1
FIGURE NO. 3

DESCRIPTION : MULTIZONE TO VAV MODIFICATION OF BASEMENT AREA



ECO-M1
FIGURE NO. 4

ENG. FORM 150
1AVC-59

Page 9

[illegible]

ENG. FORM 150
1AVC-59

PREVIOUS EDITION MAY BE USED

Page 10

ENG. FORM 150
1A VC-59

D. n. - 11

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FTLVB DLM

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP) LCCID 1.001

INSTALLATION & LOCATION: FT LEAVENWORTH, KANSAS REGION NO. 7

PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOM1

ANALYSIS DATE: 07-21-87 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	320775.
B. SIOH	\$	32078.
C. DESIGN COST	\$	16039.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	332003.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	332003.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	1287.	\$ 19949.	8.59	171358.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	4728.	\$ 14893.	12.76	190037.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		6015.	\$ 34842.		\$ 361395.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	119260.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) =		_____
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE))	\$	34842.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C)	\$	361395.
6. DISCOUNTED SAVINGS RATIO	(SIR)=(5 / 1F)=	1.09
(IF < 1 PROJECT DOES NOT QUALIFY)		

FORT LEAVENWORTH - BELL HALL BUILDING 111

ENERGY CONSERVATION OPPORTUNITY: ECO-M9

PURPOSE:

The purpose of this Energy Conservation Opportunity run (ECO-M9) is to analyze the energy savings that may be realized by converting the existing primary pumping system into a primary-secondary type pumping system. The conversion will retain the existing two- pipe heating and cooling distribution network in the facility.

SCOPE:

This E.C.O. simulation (ECO-M9) converts the existing two-pipe heating and cooling pumping system into a primary-secondary pumping system. The conversion from the existing system to a primary-secondary pumping system will require the following:

1. New primary circulation pumps
2. Modifications to the existing boiler room chilled water piping and boiler piping loops
3. Pipe modifications to connect the existing radiation pumps into the secondary loop
4. New variable speed controller units for each circulation pump
5. New electrical services for the pumps and variable speed controllers

The construction work involved in this simulation may disrupt the heating and cooling capabilities of the boiler room facility during the construction phases.

The installation of the primary and secondary pumping system will require testing and balancing of the hydronic system in the boiler room as well as the distribution network. Reference Figures No. 1 and 2 for the layout of the boiler room equipment and piping.

MODELING TECHNIQUES:

The changes made to our base model for this simulation include the following:

1. Since PC-DOE is not capable of calculating pumping energy for primary/secondary pumping (Re: **Section I, Modeling Techniques**), we calculated the average flow required for cooling and heating during one full year. We then calculated what the average head pressure would be for the existing pumps. This information was then used to redefine the pump criteria entered in the input file (Re: **Volume II, Section I**) on line No.'s 2,349 through 2,354. The following pump criteria was changed:
 - A. CIRC-DESIGN-T-DROP=9.8
 - B. CCIRC-HEAD=29'
 - C. HEAT-DESIGN-T-DROP=12.5
 - D. HEAT-HEAD=32'

SUMMARY:

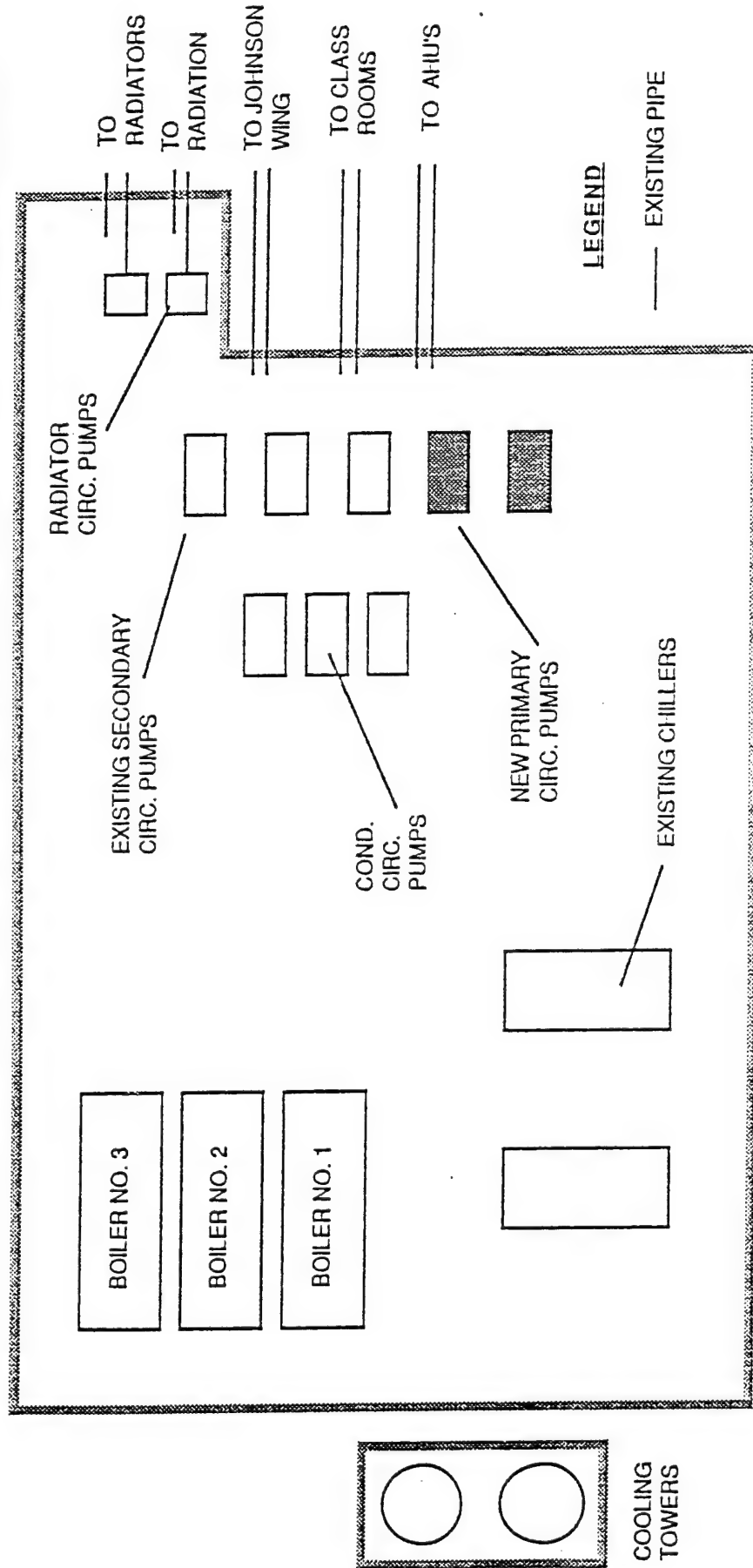
The probable project cost is \$345,792. This project cost is the construction cost plus 10% SIOH

The energy savings realized by this E.C.O. run (ECO-M9) are approximately 2,280 MBTU per year and \$38,700 per year.

The simple payback for this simulation is 8.1 years.

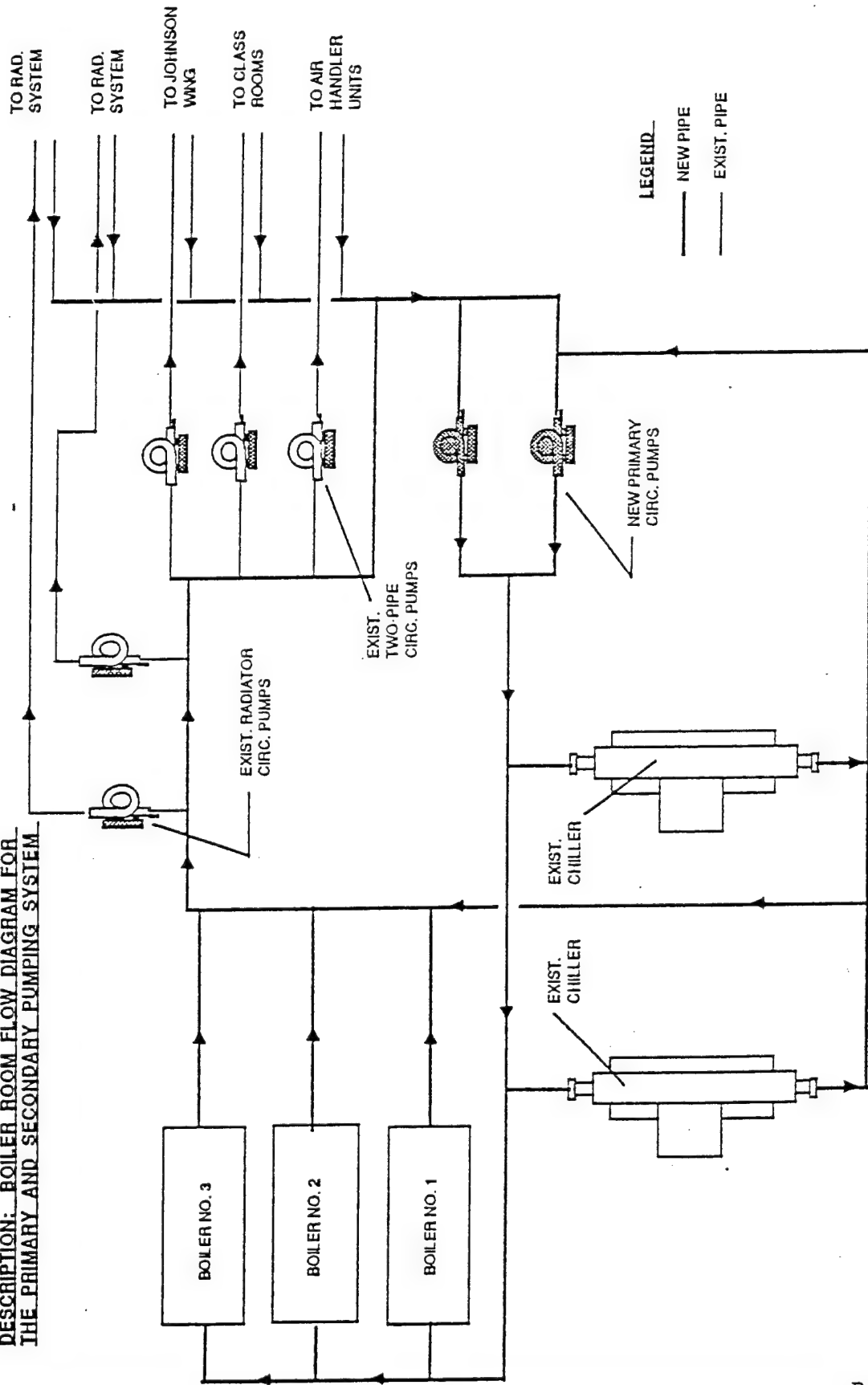
The savings to investment ratio (S.I.R.) for this simulation is 1.01.

DESCRIPTION: BOILER ROOM EQUIPMENT LAYOUT FOR PRIMARY/SECONDARY PUMPING



ECO-M9
FIGURE NO. 1

DESCRIPTION: BOILER ROOM FLOW DIAGRAM FOR THE PRIMARY AND SECONDARY PUMPING SYSTEM



ECO-M9
FIGURE NO. 2

CONSTRUCTION COST ESTIMATE				DATE PREPARED 16-Feb-87		SHEET OF 2 3	
PROJECT BELL HALL ENERGY STUDY				BASIS FOR ESTIMATE			
LOCATION FORT LEAVENWORTH, KANSAS				X CODE A (NO DESIGN COMPLETED) CODE B (PRELIMINARY DESIGN) CODE C (FINAL DESIGN) OTHER (SPECIFY)			
ARCHITECT/ENGINEER CLARK, RICHARDSON & BISKUP							
DESCRIPTION ECO-M9 (PRIMARY/SECONDARY)			ESTIMATOR J.B.		CHECKED BY G.S.		
(SUMMARY)	QUANTITY		LABOR		MATERIAL		TOTAL COST
	NO. UNITS	UNIT MEAS.	PER UNIT	TOTAL	PER UNIT	TOTAL	
DEMOLITION:							
REMOVE EXIST. CIRCULATION PUMPS	2	EA	\$325.00	\$650	\$25.00	\$50	\$700
REMOVE EXIST. ELEC. SERVICE TO PUMPS	2	EA	\$140.00	\$280	\$50.00	\$100	\$380
REMOVE 12" PIPE	180	LF	\$4.65	\$837	\$1.50	\$270	\$1,107
REMOVE 8" PIPE	700	LF	\$4.65	\$3,255	\$1.50	\$1,050	\$4,305
REMOVE 4" PIPE	200	LF	\$3.75	\$750	\$1.15	\$230	\$980
REMOVE 6" PIPE	250	LF	\$3.75	\$938	\$1.15	\$288	\$1,225
REMOVE EXIST. CONTROL VALVES	4	EA	\$10.00	\$40	\$12.00	\$48	\$88
REMOVE EXISTING ISOLATION VALVES	20	EA	\$10.00	\$200	\$12.00	\$240	\$440
CONSTRUCTION:							
INSTALL 1000 GPM PRIMARY PUMPS	2	EA	\$305.00	\$610	\$2,000.00	\$4,000	\$4,610
MODIFY EXIST. 350 GPM PUMPS	3	EA	\$205.00	\$615	\$250.00	\$750	\$1,365
PRIMARY PUMP SPEED CONTROLLER	2	EA	\$1,500.00	\$3,000	\$6,000.00	\$12,000	\$15,000
SECONDARY PUMP SPEED CONTROLLER	3	EA	\$1,500.00	\$4,500	\$6,000.00	\$18,000	\$22,500
RADIATOR PUMP SPEED CONTROLLER	2	EA	\$1,500.00	\$3,000	\$6,000.00	\$12,000	\$15,000
10" CHECK VALVES TO PRIMARY PUMPS	2	EA	\$250.00	\$500	\$3,475.00	\$6,950	\$7,450
10" PRIMARY ISOLATION VALVES	4	EA	\$120.00	\$480	\$33.00	\$132	\$612
6" SECONDARY ISOLATION VALVES	6	EA	\$90.00	\$540	\$23.00	\$138	\$678
8" ISOLATION VALVES-CHILLER/BOILER	8	EA	\$110.00	\$880	\$27.00	\$216	\$1,096
4" ISOLATION VALVES-CHILLER/BOILER	4	EA	\$77.00	\$308	\$22.00	\$88	\$396
PRIMARY/SECONDARY PUMP CONTROLS	1	LS	\$1,200.00	\$1,200	\$3,000.00	\$3,000	\$4,200
12" PIPE	200	LF	\$35.00	\$7,000	\$55.00	\$11,000	\$18,000
8" PIPE	200	LF	\$22.00	\$4,400	\$32.00	\$6,400	\$10,800
6" PIPE	150	LF	\$8.50	\$1,275	\$8.00	\$1,200	\$2,475
4" PIPE	150	LF	\$12.00	\$1,800	\$12.00	\$1,800	\$3,600
PUMP FLEX. CONNECTION	14	EA	\$35.00	\$490	\$345.00	\$4,830	\$5,320
NEW TO EXIST. UTILITY CONNECTIONS	10	EA	\$223.00	\$2,230	\$172.00	\$1,720	\$3,950
8" CONTROL VALVES	4	EA	\$800.00	\$3,200	\$200.00	\$800	\$4,000

ENG. FORM 150
1AVC-59

ENG. FORM 150
1AVC-59

LIFE CYCLE COST ANALYSIS SUMMARY

STUDY: FTLVBDLM

ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)

LCCID 1.001

INSTALLATION & LOCATION: FT LEAVENWORTH, KANSAS REGION NO. 7

PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS.

FISCAL YEAR 1987 DISCRETE PORTION NAME: ECOM9

ANALYSIS DATE: 07-22-87 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	314356.
B. SIOH	\$	31436.
C. DESIGN COST	\$	15718.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	325359.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	325359.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	2552.	\$ 39556.	8.59	339786.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	-278.	\$ -876.	12.76	-11174.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		2274.	\$ 38680.		\$ 328612.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)

(1) DISCOUNT FACTOR (TABLE A)	9.11	\$	0.
(2) DISCOUNTED SAVING/COST (3A X 3A1)		\$	0.

C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4) \$ 0.

D. PROJECT NON ENERGY QUALIFICATION TEST

(1) 25% MAX NON ENERGY CALC (2F5 X .33) \$ 108442.

A IF 3D1 IS = OR > 3C GO TO ITEM 4

B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F) = _____

C IF 3D1B IS = > 1 GO TO ITEM 4

D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 38680.

5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 328612.

6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.01

(IF < 1 PROJECT DOES NOT QUALIFY)

LIFE CYCLE COST ANALYSIS SUMMARY
ENERGY CONSERVATION INVESTMENT PROGRAM (ECIP)
INSTALLATION & LOCATION: FT LEAVENWORTH
PROJECT NO. & TITLE: DACA41-86-C-0061 FT LEAVENWORTH ESOS

STUDY: BHGROUP
LCCID 1.001

FISCAL YEAR 1987 DISCRETE PORTION NAME: GROUP3
ANALYSIS DATE: 05-31-89 ECONOMIC LIFE 15 YEARS PREPARED BY: CRB

1. INVESTMENT

A. CONSTRUCTION COST	\$	635131.
B. SIOH	\$	63513.
C. DESIGN COST	\$	31757.
D. ENERGY CREDIT CALC (1A+1B+1C)X.9	\$	657361.
E. SALVAGE VALUE COST	-\$	0.
F. TOTAL INVESTMENT (1D-1E)	\$	657361.

2. ENERGY SAVINGS (+) / COST (-)

ANALYSIS DATE ANNUAL SAVINGS, UNIT COST & DISCOUNTED SAVINGS

FUEL	UNIT COST \$/MBTU(1)	SAVINGS MBTU/YR(2)	ANNUAL \$ SAVINGS(3)	DISCOUNT FACTOR(4)	DISCOUNTED SAVINGS(5)
A. ELECT	\$ 15.50	3840.	\$ 59520.	8.59	511277.
B. DIST	\$.00	0.	\$ 0.	11.28	0.
C. RESID	\$.00	0.	\$ 0.	12.01	0.
D. NAT G	\$ 3.15	4450.	\$ 14018.	12.76	178863.
E. COAL	\$.00	0.	\$ 0.	10.17	0.
F. TOTAL		8290.	\$ 73538.		\$ 690140.

3. NON ENERGY SAVINGS(+) / COST(-)

A. ANNUAL RECURRING (+/-)	\$	0.
(1) DISCOUNT FACTOR (TABLE A)	9.11	
(2) DISCOUNTED SAVING/COST (3A X 3A1)	\$	0.
C. TOTAL NON ENERGY DISCOUNTED SAVINGS(+) /COST(-) (3A2+3BD4)	\$	0.
D. PROJECT NON ENERGY QUALIFICATION TEST		
(1) 25% MAX NON ENERGY CALC (2F5 X .33)	\$	227746.
A IF 3D1 IS = OR > 3C GO TO ITEM 4		
B IF 3D1 IS < 3C CALC SIR = (2F5+3D1)/1F=		
C IF 3D1B IS = > 1 GO TO ITEM 4		
D IF 3D1B IS < 1 PROJECT DOES NOT QUALIFY		

4. FIRST YEAR DOLLAR SAVINGS 2F3+3A+(3B1D/(YEARS ECONOMIC LIFE)) \$ 73538.
5. TOTAL NET DISCOUNTED SAVINGS (2F5+3C) \$ 690140.
6. DISCOUNTED SAVINGS RATIO (SIR)=(5 / 1F)= 1.05
(IF < 1 PROJECT DOES NOT QUALIFY)

For use of this form, see AR 420-17 and DA Pam 420-6; the proponent a

DESCRIPTION AND JUSTIFICATION OF WORK TO BE ACCOMPLISHED

REQUESTER INFORMATION

FORWARD FOR APPROVAL

APPROVAL ACTION

DA FORM 1 AUG 78 4283 EDITION OF 1 FEB 78 WILL BE USED UNTIL EXHAUSTED.

WHITE (C
PINK

5; the proponent agency is the Office of the Chief of Engineers.

FROM _____ FACILITIES ENGINEER _____ DATE	APPROVED FOR DESIGN _____ SIGNATURE DATE	SOURCE OF FUNDS <input type="checkbox"/> DIRECT <input type="checkbox"/> AUTOMATIC REIMB. <input type="checkbox"/> FUNDED REIMB.
REMARKS		

FORWARDED TO											
DESIGN						ESTIMATOR					
MO		DA		MO		DA		MO		DA	
19	20	21	22	23	24	25	26	19	20	21	22

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OF "APPROVAL ACTION" BLOCK

GREEN -- FORWARD TO KEYPUNCH AFTER
COMPLETION OF "FORWARD FOR
APPROVAL" BLOCK

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PROJECT DEVELOPMENT BROCHURE

facility

BELL HALL
FORT LEAVENWORTH, KANSAS

project coordinator for using service

functional requirements summary, PDB-1

installation: FORT LEAVENWORTH

project: HVAC MODIFICATIONS (BELL HALL)

project number
temporary: _____ program year _____

permanent: _____ category code 80000

point of contact:

user
name _____ date _____

title _____ phone _____

dfae
name _____ date _____

title _____ phone _____

engineer district
name _____ date _____

title _____ phone _____

other (A-E)
name _____ date _____

title _____ phone _____

autovon _____

reviewed by:

installation facility engineer
name _____ date _____

title _____ phone _____

autovon _____

approved by:

macom engineer
name _____ date _____

title _____ phone _____

autovon _____

project development brochure, PDB-1

OBJECTIVE

This project will provide energy savings by increasing the efficiency of the Bell Hall HVAC systems.

CURRENT CONDITIONS

Currently the existing multi-zone air handling units function as constant volume units that supply the same amount of air at varying temperatures. This requires the fans to operate at full capacity all of the time. The existing constant volume chilled water pumping system supplies the same amount of chilled water throughout the building, regardless of the cooling requirement. The temperatures are maintained by mixing return chilled water with the supply chilled water. This requires that the pumps operate at design capacity all of the time.

PROPOSED MODIFICATIONS

This project would convert 5 existing multizone air handling units to allow operation as variable air volume units and convert the existing constant volume chilled water pumping system to a variable flow primary/secondary pumping system.

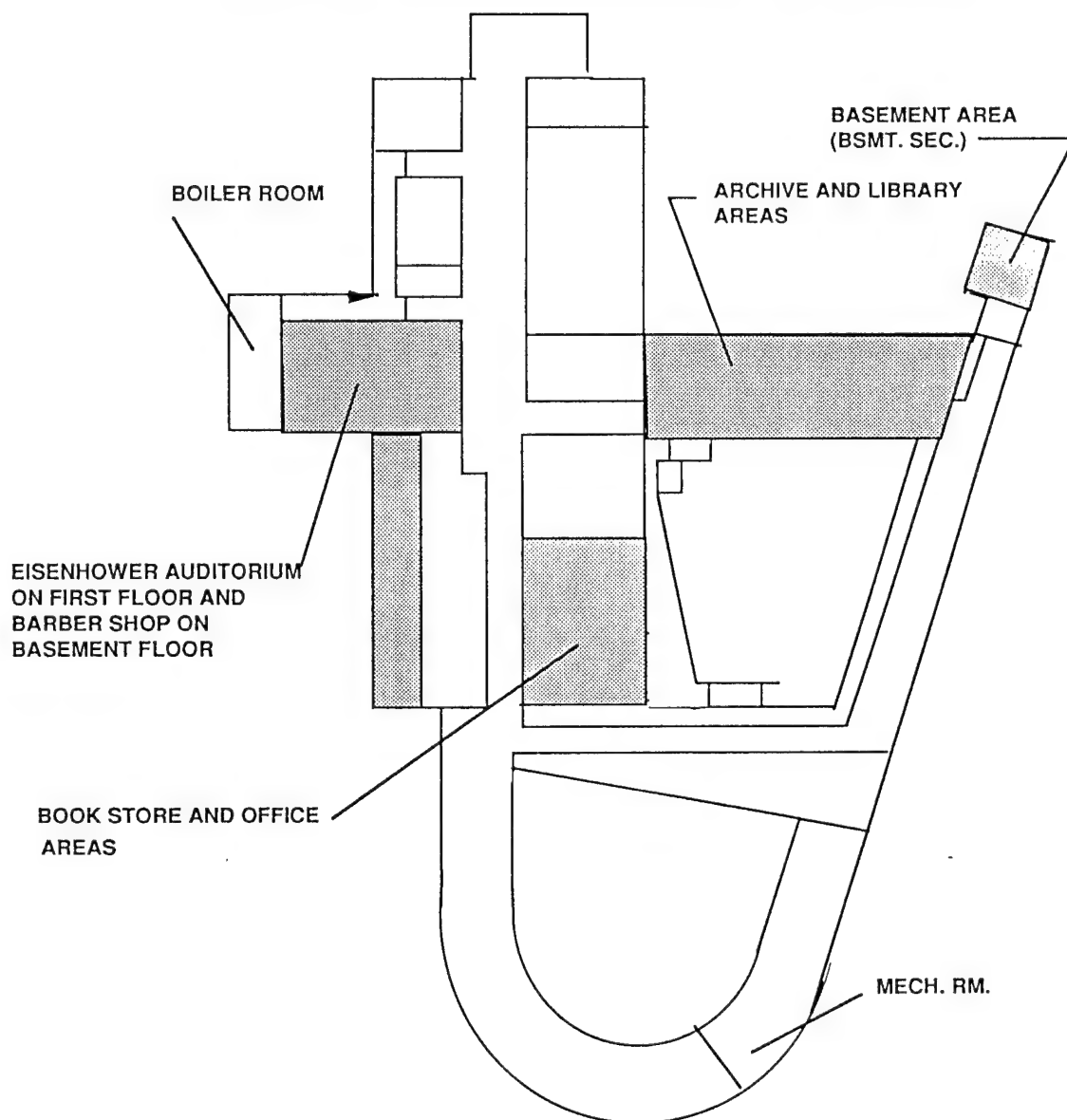
The multizone units converted to VAV would serve the basement office area, library area, archive area, Eisenhower Auditorium area and the bookstore and barbershop area. The conversion would consist of a variable speed controller on the fan motors, control modifications, and installation of variable volume supply boxes in the individual areas.

The conversion of the constant volume pumping system would include, new primary circulation pumps, modifications to the chilled water and heating water piping loops, new variable speed controllers for the secondary circulation pumps and DDC control modifications.

The electrical savings is 8289 MBTU's per year and the the savings to investment ratio is 1.05.

functional requirements summary, PDB-1

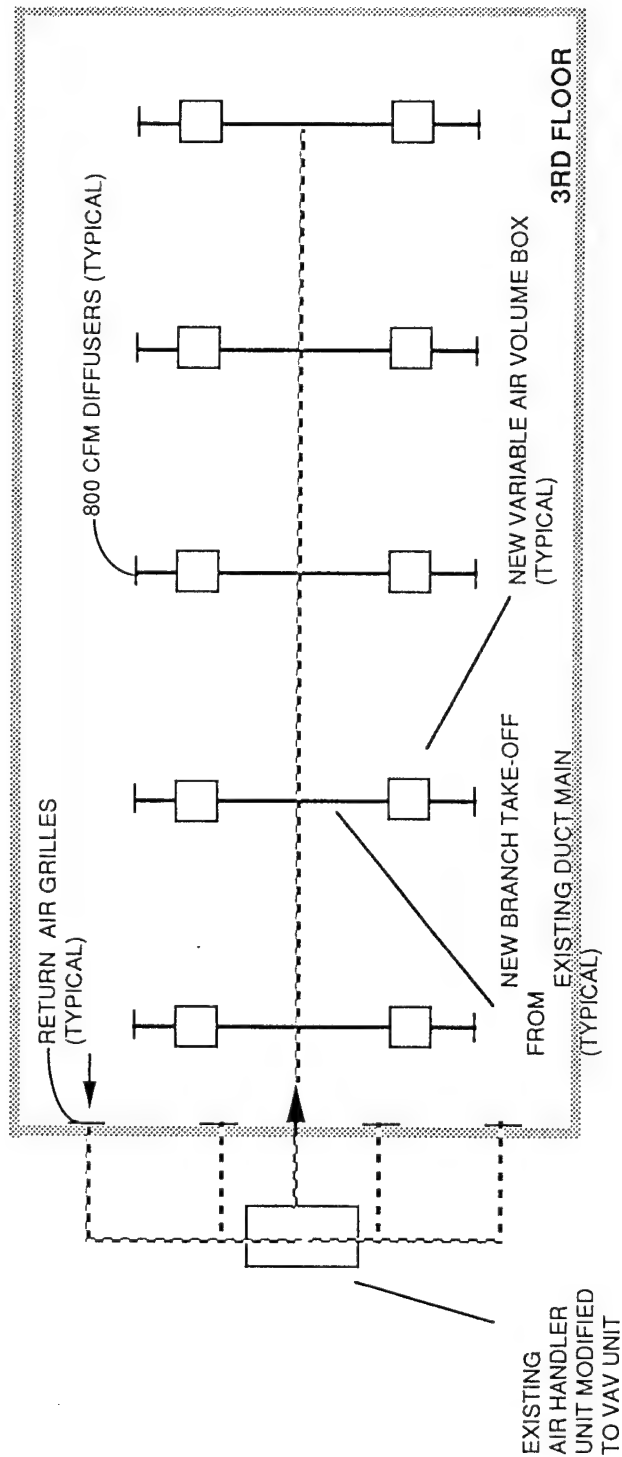
DESCRIPTION: FLOOR PLAN OF EXISTING MULTI-ZONE AREAS



ECO-M1
FIGURE NO.1

facilities requirements sketch, PDB- 1/2

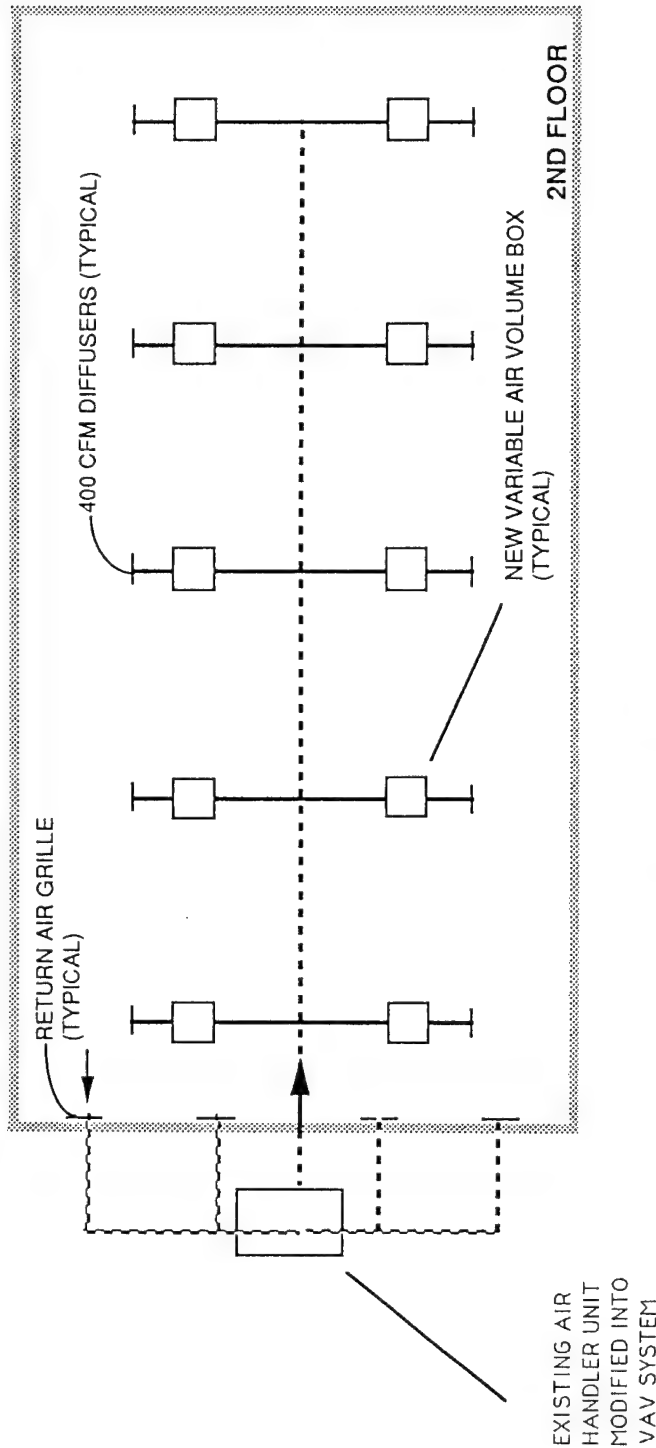
DESCRIPTION : ARCHIVE AREA VARIABLE AIR VOLUME SYSTEM



ECO-M1
FIGURE NO. 2

facilities requirements sketch, PDB- 1/2

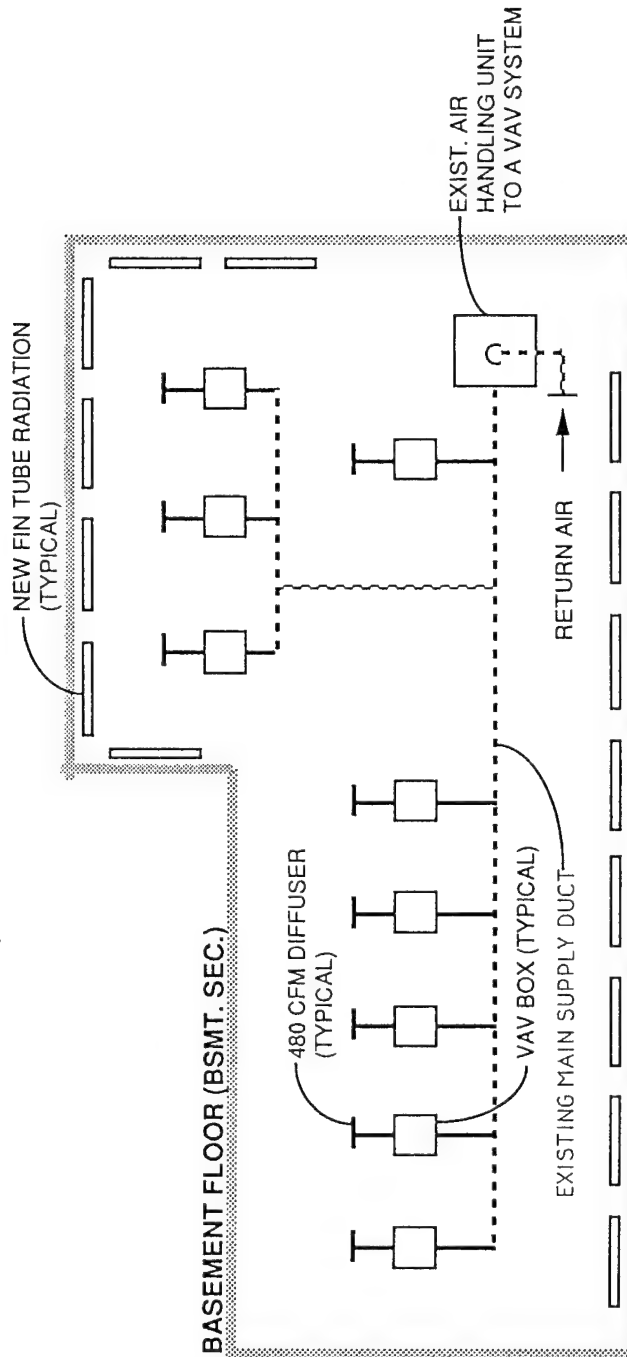
DESCRIPTION : LIBRARY VARIABLE AIR VOLUME SYSTEM



ECO-M1
FIGURE NO. 3

facilities requirements sketch, PDB- 1/2

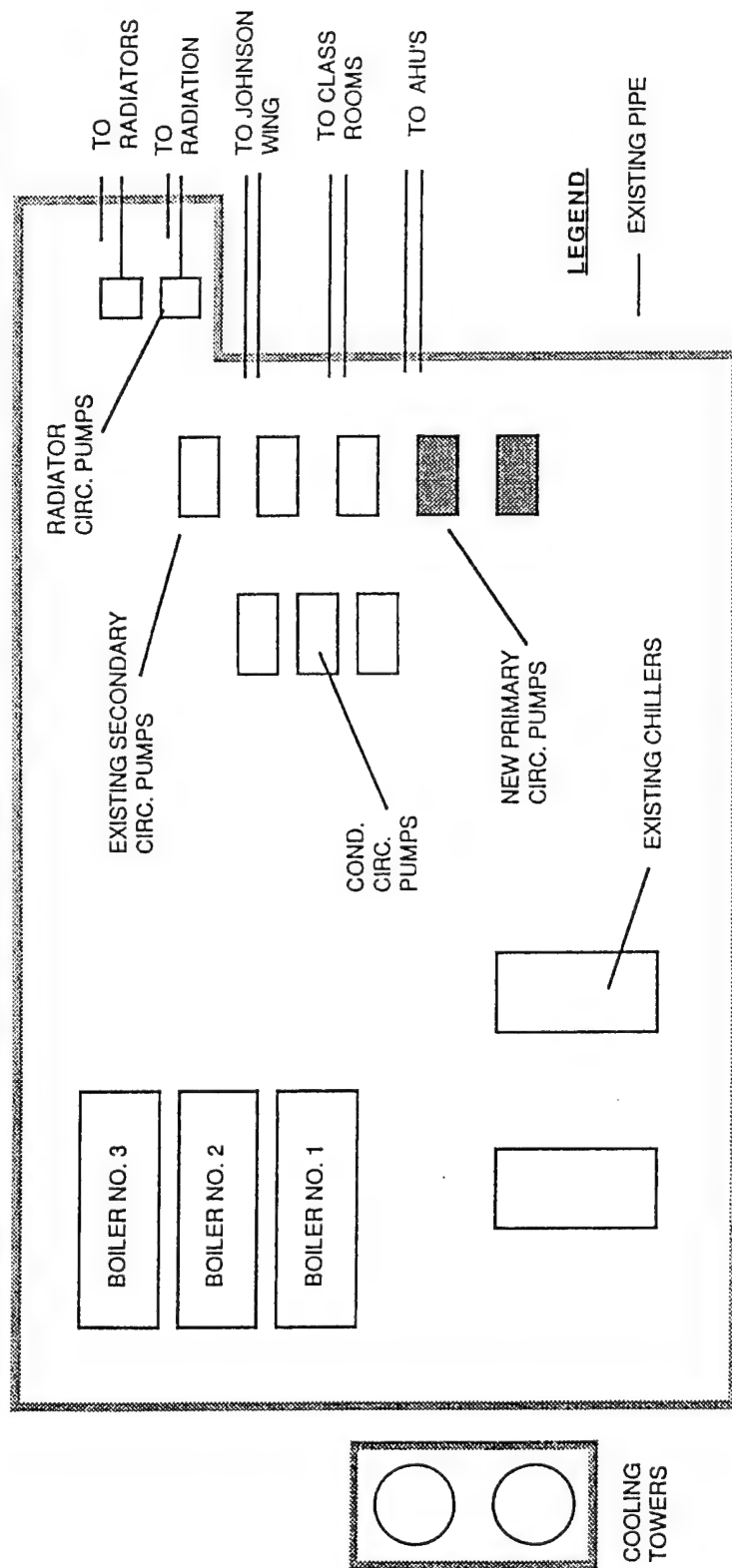
DESCRIPTION : MULTIZONE TO VAV MODIFICATION OF BASEMENT AREA



ECO-M1
FIGURE NO. 4

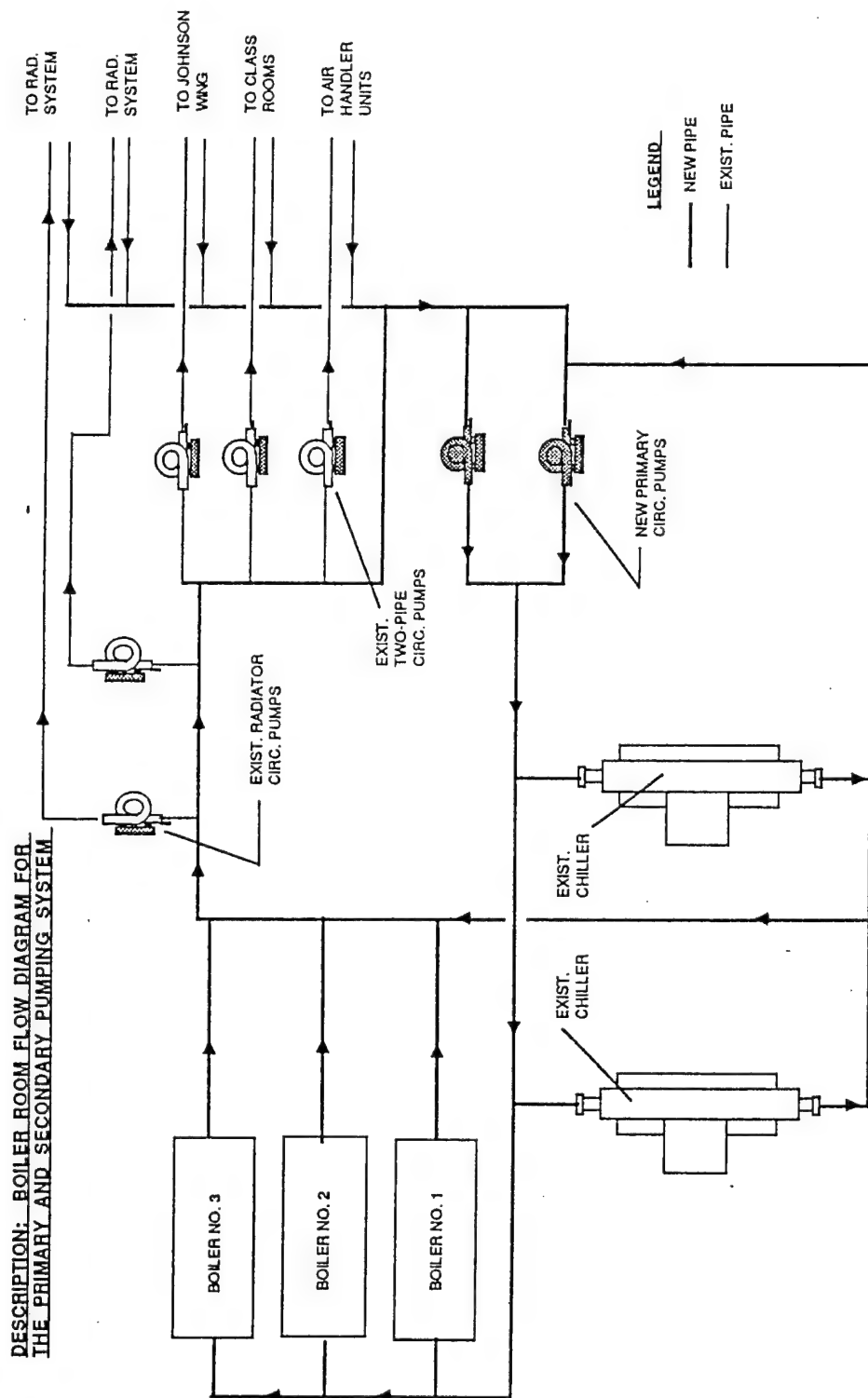
facilities requirements sketch, PDB- 1/2

DESCRIPTION: BOILER ROOM EQUIPMENT LAYOUT FOR PRIMARY/SECONDARY PUMPING



ECO-M9
FIGURE NO. 1

facilities requirements sketch, PDB- 1/2



ECO-M9
FIGURE NO. 2

facilities requirements sketch, PDB- 1/2

A. SPECIAL CONSIDERATIONS**ITEM**

A-1	Cost estimates for each primary and supporting facility
A-2	Telecommunications system coordination with USACC & authorization for exemptions
A-3	Coordination with state and local governmental requirements (blind vendors, medical facilities, construction and operating permits, clearinghouse coordination, etc.)
A-4	Assignment of airspace
A-5	Economic analysis of alternatives
A-6	Approval for new starts
A-7	International balance of payments (IBOP) coordination with U.S. European command and NATO-overseas cost estimates and comparables (include rate of exchange used)
A-8	Impact on historic places-on site survey by authorized archeologist and coordination with state historic preservation officer and advisory council on historic preservation
A-9	Exceptions to established criteria
A-10	Coordination with various staff agencies (Provost Marshall-physical security, etc.)
A-11	Identification of related support projects (so projects can be coordinated)
A-12	Required completion date
	Other Special Considerations (List and number items)

Required or Not Required	To Be * Determined	Comment Attached	Document Attached
R	D		√
NR			
NR			
NR			
R			√
NR			
NR			
NR			
NR			
R	B		
NR			

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DOCUMENT ATTACHED - Significant information is in an existing document which is attached.

* BY WHOM (Check and insert appropriate letter)

A - DFAE

B - Using Service

C - Construction Service

D - Designer

E - Other (Check Comments Attached and explain)

documentation checklist

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined *	Comment Attached	Document Attached
B-1	Consultation with the District Office to determine and evaluate flood plain hazards	NR			
B-2	Preparation, submission, and/or approval of new	NR			
(A)	General Site Plan				
(B)	Annotated General Site Plan	NR			
(C)	Sketch Site Plan	NR			
(D)	Facilities Requirements Sketch	NR			
B-3	Preparation of	NR			
(A)	Site Survey				
(B)	Subsoil information	NR			
B-4	Approval by Department of Defense Explosive Safety Board (DDESB) for Safety Site Plan				
	Other Site Development Considerations (List and number items)				

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documentation checklist

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
C-1	Reconciliation with troop housing programs and requirements	NR			
C-2	Evaluation of existing facilities (including degree of utilization)	NR			
C-3	Approval for removal and relocation of existing useable facilities	NR			
C-4	Evaluation of off-post community facilities	NR			
C-5	Storage and maintenance facilities (including nuclear weapons)	NR			
C-6	Coordination hospitals, medical and dental facilities with Surgeon General	NR			
C-7	Coordination of aviation facilities with FAA	NR			
C-8	Coordination air traffic control and navigational aids with USACC	NR			
C-9	Tabulation of types and numbers of aircraft	NR			
C-10	Evaluation of laboratory, research and development, and technical maintenance facilities	NR			
C-11	Coordination chapels with Chief of Chaplains	NR			
C-12	Review food service facilities by USATSA	NR			
C-13	Automated data processing system or equipment approvals—cost analysis when ADP and/or communication centers not co-located with related facilities	NR			
C-14	Coordination postal facilities with U.S. Postal Service Regional Director	NR			
C-15	Laundry and dry cleaning facilities coordination with ASD(I&L)	NR			
C-16	Tenant facilities coordination with installation where sited	R	A		
C-17	Facilities for or exposed to explosions, toxic chemicals, or ammunition—review by DDESB (See also Item B-4)	NR			
C-18	Analysis of deficiencies	R			✓
C-19	Consideration of alternatives	R			✓
C-20	Determination whether occupants will include physically handicapped or disabled persons	NR			
C-21	As-build drawings for alterations or additions	R	C		
C-22	Availability of Standard Design or site adaptable designs	NR			
Other Architectural & Structural (List and number items)					

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documentation checklist

E. ENVIRONMENTAL CONSIDERATIONS

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
E-1	Environmental impact assessment	NR			
E-2	EIA conclusions require Environmental Impact Statement	NR			
E-3	Determination of health, environmental or related hazards. Assistance to determine existence of any health, environmental or related hazard may be requested from Aberdeen Proving Ground, MD 21010, the Office of the Surgeon General, Attn: DASG-HCH (Army Environmental Hygiene Agency)	NR			
E-4	Air/water pollution permit, coordination with agencies and compliance with standards at Federal, state and local level	NR			
E-5	Corrective measures associated with Environmental Impact Statements or assessment—list separately and evaluate.	NR			
	Other environmental considerations (list and number items)				

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documentation checklist

DA FORM 5023-E-R, Feb 82

TM 5-800-3

C-13

A. SPECIAL CONSIDERATIONS

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
A-1	Factors of risk, restriction or unusual circumstance expected to increase costs beyond applicable area averages	R	D		
A-2	Construction phasing requirements	R	D		
A-3	Functional support equipment (mechanical, electrical, structural, and security) to be built in	R	D		
A-4	Equipment in place and justification	NR			
A-5	Other equipment and furniture (O&MA, OPA) and costs	NR			
A-6	Special studies and tests (hazards analyses, compatibility testing, new technology testing, etc.)	NR			
A-7	Type of construction (permanent, temporary, semi-permanent)	R	D		
A-8	Government furnished equipment (quantities, procurement time, availability and special handling and storage requirements). Funds used for procurement.	NR			
Other special considerations (list and number items)					

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technical data checklist

DA FORM 5024-A-R, Feb 82

TM 5-800-3

D-5

B. SITE DEVELOPMENT

ITEM		Required or Not Required	To Be Determined	Comment Attached	Document Attached
B-1	Construction restrictions or guidelines pertaining to site access and preferred construction routes	NR			
(A)					
(B)	Airfield clearance, explosive storage, working hours, safety, etc.	NR			
(C)	Facilities and/or functions or adjoining areas (structures, materials, impact)	NR			
B-2	Real estate actions (acquisition, disposal, lease, right-of-way)	NR			
B-3	Demolition/relocation required (data)				
(A)	Special considerations due to explosives/radioactivity/chemical contamination/asbestos emissions/toxic gases	NR			
(B)	Restrictions on disposal of demolished/relocated material including hazardous waste	NR			
B-4	Pavement types and requirements (including traffic surveys and MTMC coordination)	NR			
B-5	Landscape considerations				
(A)	Protection of existing vegetation	NR			
(B)	Stockpile topsoil	NR			
Other Site Development (List and number items)					

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technical data checklist

DA FORM 5024-B-R, Feb 82

TM 5-800-3

D-7

C. ARCHITECTURAL & STRUCTURAL

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
C-1	Vibration-producing equipment requiring isolation	R	D		
C-2	Seismic zone and other design load criteria (typhoon, hurricane, earthquake loads, high or low loss potential)	R	D		
C-3	Protective shelter evaluation and resistant design criteria (conventional/nuclear blast and radiation, chemical/biological)	NR			
C-4	Unusual foundation requirements (pier, pile, caisson, deep foundations, mat, special treatment, permafrost areas, soil bearing)	NR			
C-5	Designation and strength of units to be accommodated	NR			
C-6	Requirements and data for special design projects	NR			
C-7	Unusual floor and roof loads (safes, equipment)	NR			
C-8	Security features (arms rooms, vaults, interior secure areas)	NR			
Other Architectural & Structural (List and number items)					

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technical data checklist

D. MECHANICAL, ELECTRICAL, & UTILITY SYSTEMS

ITEM		Required or Not Required	To Be * Determined	Comment Attached	Document Attached
D-1	Special mechanical requirements or considerations (elevator, crane, hoist, etc.)	NR			
D-2	Special peak usage periods and peak leveling techniques	NR			
D-3	Maintenance considerations (accessibility of equipment, compatibility with existing equipment)	R	D		
D-4	Plumbing—availability, general system type and characteristics (proposed and/or existing, incl. compressed air and gas)	NR			
D-5	Heating—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-6	Ventilating, air condition/refrigeration—availability, general system type and characteristics (proposed and/or existing)	R	D		
D-7	Electrical—availability, general system type and characteristics incl. airfield lighting, communication, etc. (proposed and/or existing)	R	D		
D-8	Water supply/waste treatment—availability, general system type and characteristics (proposed and/or existing)	NR			
D-9	Energy requirements/fuel conversion (sources, availability, loads, types of fuel, etc.)	NR			
D-10	Solar energy evaluation				
	Other Mechanical & Utility Systems (List and number items)				

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technical data checklist

DA FORM 5024-D-R, Feb 82

E. ENVIRONMENTAL CONSIDERATIONS

ITEM		Required or Not Required	* To Be Determined	Comment Attached	Document Attached
E-1	Waste water treatment, air quality, and solid waste disposal criteria Other Environmental Considerations (List and number items)	NR			

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technical data checklist

DA FORM 5024-E-R, Feb 82

TM 5-800-3 D-13

F. FIRE PROTECTION

ITEM		Required or Not Required	* To Be Determined	Comment Attached	Document Attached
F-1	Special fire protection systems or features (detection and suppression equipment, hazards, etc.)	NR			
	Other Fire Protection Considerations (List and number items)				

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technical data checklist

DA FORM 5024-F-R, Feb 82

TM 5-800-3

D-15

FORM 1391

1. COMPONENT ARMY		FY 1990 MILITARY CONSTRUCTION PROJECT DATA			2. DATE 5-Jun-90	
3. INSTALLATION AND LOCATION FORT LEAVENWORTH, KANSAS			4. PROJECT TITLE HVAC Modifications (Bell Hall)			
5. PROGRAM ELEMENT		6. CATEGORY CODE 80000	7. PROJECT NUMBER		8. PROJECT COST \$700,000	
9. COST ESTIMATES						
ITEM			U/M	QUANTITY	UNIT COST	COST (\$000)
<u>Steam and/or Chilled Water Distribution.</u>						
Convert CHW system to Primary/Secondary Pumping			LS	1	\$345,792	\$346
<u>Air Conditioning</u>						
Convert Multi-Zone AHU to VAV			LS	1	\$353,853	\$354
Facility Subtotal					\$699,645	\$700
10. DESCRIPTION OF PROPOSED CONSTRUCTION						
<p>This project would convert 5 existing multi-zone air handling units to allow operation as variable air volume units and convert the existing constant volume chilled water pumping system to a variable flow primary/secondary pumping system.</p> <p>The multi-zone units converted to VAV would serve the basement office area, library area, archive area, Eisenhower Auditorium area and the bookstore and barbershop area. The conversion would consist of a variable speed controller on the fan motors, control modifications, and installation of variable volume supply boxes in the individual areas.</p> <p>The conversion of the constant volume pumping system would include, new primary circulation pumps, modifications to the chilled water and heating water piping loops, new variable speed controllers for the secondary circulation pumps and DDC control modifications.</p> <p>The electrical savings is 8289 MBTU's per year and the the savings to investment ratio is 1.05.</p>						

1. COMPONENT ARMY	FY 1990 MILITARY CONSTRUCTION PROJECT DATA	2. DATE Jun 5, 1990
3. INSTALLATION AND LOCATION FORT LEAVENWORTH, KANSAS		
4. PROJECT TITLE HVAC Modifications (Bell Hall)		5. PROJECT NUMBER
<p>11.J REMARKS:</p> <p>This project will provide energy savings by increasing the efficiency of the Bell Hall HVAC systems.</p> <p>11.K RELATED PROJECTS:</p> <p>No other project are dependent upon this project.</p> <p>11.L PROJECT:</p> <p>Conversion of the existing multi-zone air handling units to allow operation as variable air volume units and conversion of the existing constant volume chilled water pumping system to a variable flow primary/secondary pumping system.</p> <p>11.M REQUIREMENT</p> <p>a. This project will aid in reducing the consumption of electricity to help meet national energy reduction goals which is the reason for the ESOS and ECIP programs.</p> <p>b. All buildings will be in active use during the amortization period.</p> <p>11.N CURRENT SITUATION:</p> <p>Results from the field survey indicate that the existing systems are currently meeting the requirements cond of the facility. However, this project improves the efficiency of the HVAC systems by allowing them to modulate and follow the changes in the air conditioning loads. The current systems are constant volume and run at full air flow and water flow capacity all of the time, which uses more fan and pump horsepower than the variable flow systems.</p> <p>11.O IMPACT IF NOT PROVIDED:</p> <p>If this project is not approved, the electrical energy consumption will remain the same and will not contribute to the energy saving goals of the DOD.</p>		

1. COMPONENT ARMY	FY 1990 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 5-Jun-90
3. INSTALLATION AND LOCATION FORT LEAVENWORTH, KANSAS		
4. PROJECT TITLE HVAC Modifications (Bell Hall)		5. PROJECT NUMBER
<p>D1. GENERAL:</p> <p>This project is required as part of the DOD plan to reduce the energy consumption per gross square foot of building area. This project improves the efficiency of the air conditioning systems at Bell Hall, located at Fort Leavenworth. The primary mission of Ft. Leavenworth is the Military War College. This building is the primary center for this function. This project does not involve the arrival of a new weapons system.</p> <p>D2. ACCOMMODATIONS NOW IN USE:</p> <p>Building 111, Bell Hall.</p> <p>D3. ANALYSIS OF DEFICIENCY:</p> <p>Currently the existing multi-zone air handling units function as constant volume units that supply the same amount of air at varying temperatures. This requires the fans to operate at full capacity all of the time. The existing constant volume chilled water pumping system supplies the same amount of chilled water throughout the building, regardless of the cooling requirement. The temperatures are maintained by mixing return chilled water with the supply chilled water. This requires that the pumps operate at design capacity all of the time.</p> <p>D4. CONSIDERATION OF ALTERNATIVES:</p> <p>The alternatives to reduce fan and pump horsepower involve reducing air and water flows or modifying existing duct and piping supply & return systems to reduce pressure drops. Reducing the air and water flows was unacceptable because the system would not meet peak load requirements. Modifying the existing duct and piping alternatives were rejected because of high capital costs and excessive downtime required for construction, and the minimal benefit.</p> <p>D5. CRITERIA FOR PROPOSED CONSTRUCTION:</p> <p>The proposed project will conform with all applicable Federal and US Army regulations.</p> <p>D6. PROGRAM FOR RELATED FURNISHINGS AND EQUIPMENT:</p> <p>Not applicable.</p> <p>D7. DISPOSAL OF PRESENT ASSETS:</p> <p>Not applicable.</p> <p>D8. SURVIVAL MEASURES:</p> <p>Not applicable.</p> <p>D9. SUMMARY OF ENVIRONMENTAL CONSEQUENCES:</p> <p>This project has no environmental consequences, other than a reduction in energy use, which translates to a positive impact.</p>		

1. COMPONENT ARMY	FY 1990 MILITARY CONSTRUCTION PROJECT DATA	2. DATE 5-Jun-90										
3. INSTALLATION AND LOCATION FORT LEAVENWORTH, KANSAS												
4. PROJECT TITLE HVAC Modifications (Bell Hall)		5. PROJECT NUMBER										
<p>D10. EVALUATION OF FLOOD HAZARDS:</p> <p>Not applicable.</p> <p>D11. ECONOMIC JUSTIFICATION:</p> <p>See attached LCCID printouts.</p> <p>D12. UTILITY AND COMMUNICATIONS SUPPORT:</p> <p>No new utilities are required for support of this project.</p> <p>D13. PROTECTION OF HISTORIC PLACES AND ARCHAEOLOGICAL SITES:</p> <p>The proposed project will not alter building construction or appearance.</p> <p>D14. PROJECT DEVELOPMENT BROCHURE:</p> <p>A Project Development Brochure has been prepared.</p> <p>D15. ENERGY REQUIREMENTS:</p> <p>A summary of the results of the full energy study follows.:</p> <table> <tr> <td>Annu :</td> <td>3840 MBTU's per year electricity</td> </tr> <tr> <td></td> <td>4450 MBTU's per year natural gas</td> </tr> <tr> <td>Total :</td> <td>\$690,140</td> </tr> <tr> <td>Initial :</td> <td>\$657,361</td> </tr> <tr> <td>Savin :</td> <td>1.05</td> </tr> </table> <p>D16. PROVISIONS FOR THE HANDICAPPED:</p> <p>Not applicable.</p> <p>D17. REAL PROPERTY MAINTENANCE ACTIVITY (RPMA):</p> <p>The completion of this project will not have an impact on property maintenance.</p> <p>D18. COMMERCIAL ACTIVITIES (CA) ANALYSIS:</p> <p>Not applicable. This project does not constitute a new start or expansion.</p>			Annu :	3840 MBTU's per year electricity		4450 MBTU's per year natural gas	Total :	\$690,140	Initial :	\$657,361	Savin :	1.05
Annu :	3840 MBTU's per year electricity											
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